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Figure 1. Model MEA-1500 is pictured with optional test lead boom, distributorless ignition link, test stand, and printer.

INTRODUCTION

General Information

The Modular Engine Analyzer, Model MEA-1500, shown in Figure 1, displays test data for the detection of abnormal operating conditions in gasoline internal-combustion engines. It is microprocessor-controlled and electronically self-calibrating. Testing is accomplished through:

- a 12-inch oscilloscope ("scope") that displays ignition and alternator scope patterns.
- a 12-inch video display unit (VDU) that displays digital test data and plain language instructional messages which provide assistance in operating the tester.
- a remote control that permits operation of both the VDU and scope from behind the wheel or under the hood.

The analyzer's standard and optional test capabilities and hardware are shown in Figures 2 and 3. The MEA-1500 Operator's Manual presents illustrated instructions for operating the analyzer with all options installed. Refer to "Accessories" for a complete listing with part numbers of standard and optional accessories.

MEA-1500 Test Capabilities

Standard	Optional
• RPM	• HC, CO, CO_2, O_2 emissions module
• Dwell	• Coil (+) kit
• Strobe timing	• Mag timing kit
• Battery voltage	• Amps/Vac kit
• Distributor volts	
• Pinpoint volts/ohms	
• Scope volts, kilovolts, milliseconds	

Figure 2. Standard And Optional Test Capabilities.

MEA-1500 Hardware

Standard	Optional
• Analyzer console (12" scope and 12" VDU)	• Industry-standard printer
• Remote control	• Model DIL-180 Distributorless Ignition Link
• Serial I/O port	• Test lead boom
• Leads, connectors and adapters	• Test stand
	• Leads, connectors and adapters

Figure 3. Standard And Optional Analyzer Hardware

Safety Precautions

The following precautions must always be observed when doing automotive testing.

1. Exhaust gases contain carbon monoxide which is a colorlerss and odorless lethal gas. Always work in properly ventilated areas.
2. Gasoline fumes are explosive. Do not smoke around gasoline.
3. Wipe up gasoline spills immediately and dispose of soaked rags in proper air-tight containers. Always stop leaks and clean spills immediately.
4. Check the engine oil level and add oil if necessary before testing. A vehicle should not be tested if it is low on oil.
5. Check the coolant level before testing. A vehicle should not be tested if it is low on coolant. If the engine is hot, check the level of the overflow tank.

   CAUTION: Do not open closed coolant systems while the fluid is hot.
6. Do not wear loose clothing or a necktie near an operating engine. Keep hands and hair away from moving engine parts such as fan blades, belts, or pulleys.
7. Be particularly careful not to operate the timing light too near fans or belts. The timing light may have the effect of making the fan seem to "stand still". This is a dangerous optical illusion which might cause the operator to contact the fan.
8. Safety goggles should be used when working on a vehicle to protect eyes from acid, dust, gasoline, or objects which may fly off moving parts.
9. Never look directly into the carburetor throat when cranking or running the engine. Backfiring may cause burns.
10. Never wear wrist watches, rings, or other jewelry when working on a vehicle. Such items may catch on moving parts or cause electrical short circuits, burning the wearer.
11. Avoid contact with hot surfaces such as exhaust manifolds and pipes, mufflers, catalytic converters, or radiators and hoses.
12. Do not lay tools or equipment on the battery. Accidental grounding of the battery terminals may cause shocks or burns, damage wiring, or damage the battery itself. Battery acid can damage clothing and burn skin or eyes. If you contact battery acid, wash with as much water as possible and use weak soda (such as baking soda) to neutralize the acid. If acid enters your eyes, see a doctor as soon as possible.
13. A fire extinguisher should always be kept in the work area. The extinguisher should be suitable for a range of uses including gasoline, chemical, and electrical fires.
14. High voltage is present in the secondary side of the ignition system. Always use insulated pliers when handling ignition system components while the engine is running.
15. Hydrogen gas is produced by automotive batteries. Flame or sparks near the battery may cause it to explode.
16. Place wheel chocks in front of and at the rear of the drive wheels before testing a vehicle.

OVERVIEW

Operator VDU Messages

With the exception of the oscilloscope, the MEA-1500 operates entirely through individual display screens, called "pages", which appear on the Video Display Unit, commonly referred to as a VDU. A "menu" page contains a list of options from which the operator is prompted to make selections.

To make menu selections, and to advance from page to page, the operator follows the prompt messages which appear on the VDU. Prompt messages usually ask the operator to make remote control entries. If a specific key should be pressed to complete a required action, the key's abbreviation will be highlighted in reverse video on the VDU. This means the key letters will be contrasted in black against a bright green VDU background.

Status indicators are another type of operator message, which indicate the state of tester settings, controls, and hookups. Some status indicators will flash on the VDU when the operator's immediate attention is required. For example, the TRIGGER PICKUP NOT SENSED message flashes on the POWER BALANCE page if the trigger pickup is not connected properly.

"Help" messages are supplementary pages which tell the operator how to perform a specific task. They contain information on 1) analyzer set-up, 2) vehicle set-up, 3) analyzer operation and 4) vehicle connections. The help messages (which explain the tasks related to an individual page) are available by pressing the HELP key when the page is displayed.

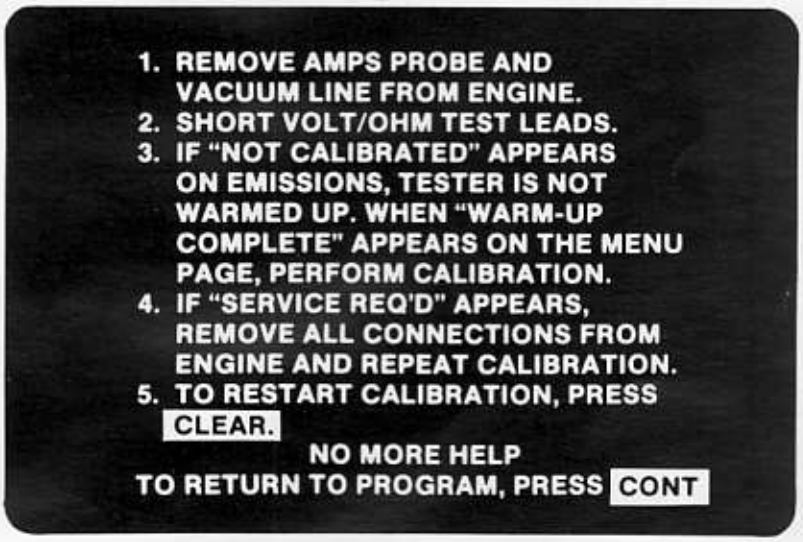

1. REMOVE AMPS PROBE AND VACUUM LINE FROM ENGINE.
2. SHORT VOLT/OHM TEST LEADS.
3. IF "NOT CALIBRATED" APPEARS ON EMISSIONS, TESTER IS NOT WARMED UP. WHEN "WARM-UP COMPLETE" APPEARS ON THE MENU PAGE, PERFORM CALIBRATION.
4. IF "SERVICE REQ'D" APPEARS, REMOVE ALL CONNECTIONS FROM ENGINE AND REPEAT CALIBRATION.
5. TO RESTART CALIBRATION, PRESS CLEAR.
NO MORE HELP
TO RETURN TO PROGRAM, PRESS CONT

Figure 4 shows a help message which can be reached from the CALIBRATION page and explains what the operator needs to know to successfully complete calibration. Note the prompt message at the bottom of the page with key in reverse video.

Program Menu

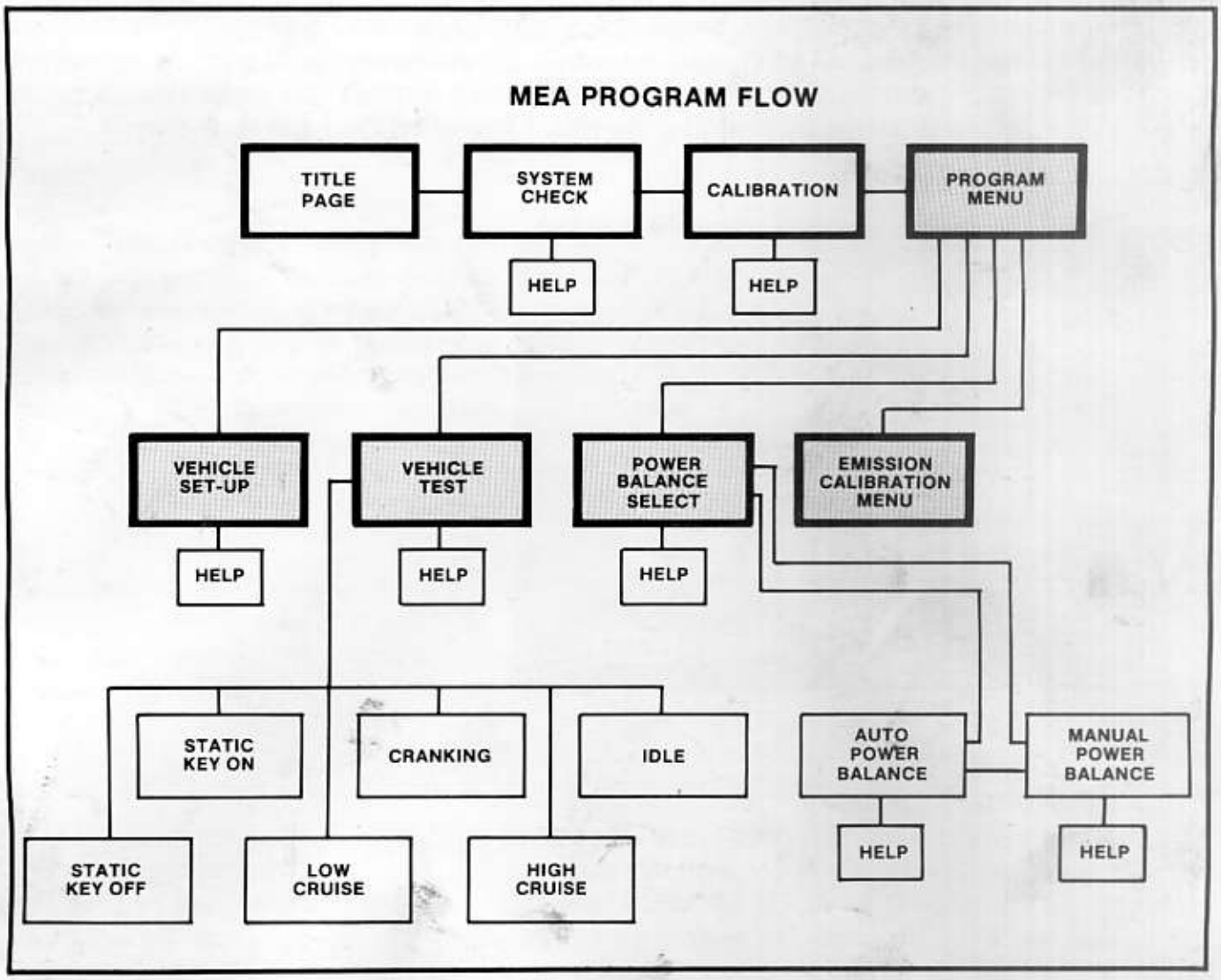
The analyzer's primary menu is the PROGRAM MENU page (Figure 5), which contains four options. Brief descriptions of each option's purpose and principal features appear in the following paragraphs. The PROGRAM MENU page can be reached at any time by pressing the MENU key once or twice, depending on where you are in the program. To select an option on the PROGRAM MENU, press the key number corresponding to the menu selection on the remote control.

```
PROGRAM MENU

1.  VEHICLE SET-UP
2.  VEHICLE TEST
3.  POWER BALANCE
4.  CALIBRATION

12 MINUTE WARMUP IN PROGRESS
```

Figure 5 shows the Program Menu from which the operator selects the desired analyzer function.



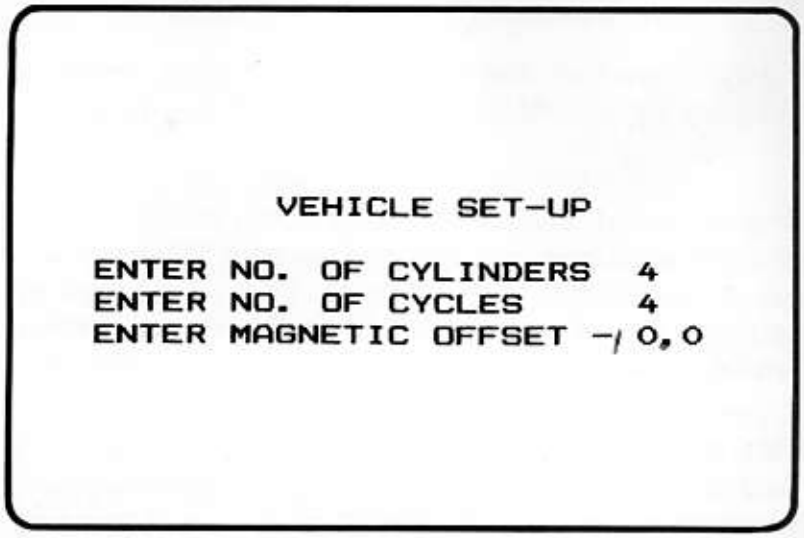


Figure 6. The engine analyzer is preset for the most common four-cylinder vehicles. Help messages detail how to change the settings if needed.

Selection #1: Vehicle Set-up

The VEHICLE SET-UP page (Figure 6) is used to set three vehicle specifications: no. of cylinders, no. of cycles and magnetic offset angle.

Upon analyzer power-up, the vehicle set-up is preset for 4-cylinders, 4-cycles, and a magnetic offset angle of 0.0.

The analyzer accepts 3, 4, 5, 6, 8 and 12 cylinders, two or four cycles, and magnetic offset angles of between 0 and -359.9 degrees. A list of mag offset angles for Ford, GM, Chrysler and European vehicles appears in the MEA-1500 Quick Reference Guide. The mag offset angle and the no. of cylinders selected appear at the bottom of the VEHICLE TEST page. Refer to Figure 7.

If the vehicle being tested is equipped with built-in magnetic timing sensors, the magnetic offset angle will automatically be adjusted, and will override any preset angles. This usually applies to European vehicles only and the angle will be preset to -20 or 0.

The operator can quickly advance to the VEHICLE SET-UP page from any other page by pressing the SETUP key, and return to the original page by pressing the CONT key. Refer to "Test Preparation" and "Controls" for data entry instructions.

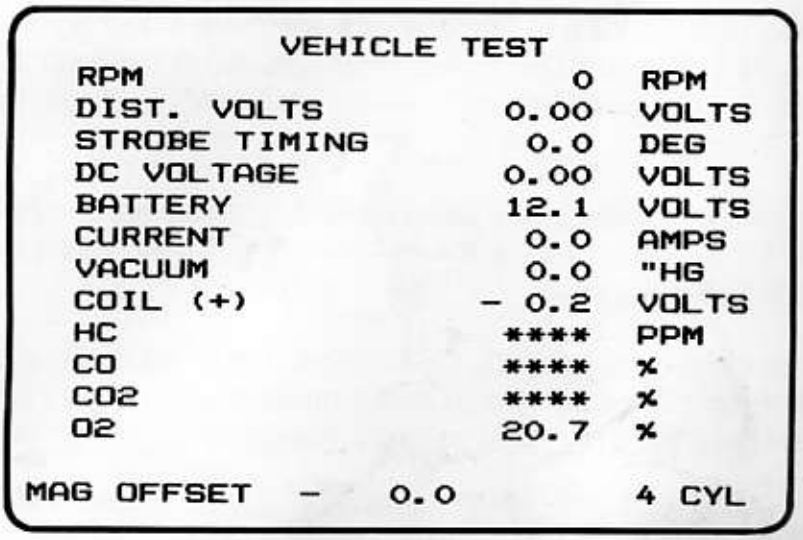


Figure 7. Help messages that detail how to hookup the vehicle for testing can be reached from this page. Note the first and second lines (RPM and Dist. Volts). Dist. volts changes to Dwell when there is RPM. The asterisks by the gas readouts indicate that the emissions module is not calibrated, or not warmed up. The strobe timing line changes to mag timing when mag timing pulses are sensed. If an option is not installed, NOT ACTIVE will appear next to its test measurement.

Selection #2: Vehicle Test

The VEHICLE TEST page (Figure 7) is used to perform key-on and key-off tests, cranking tests, running tests, pinpoint tests and vehicle adjustments. Refer to "Test Procedures" for instructions.

Standard test measurements include engine speed, dwell/distributor volts, strobe timing, DC voltage/ohms, and battery. Dwell is measured in both degrees and percent. When RPM is 0, the dwell reading on the VDU changes to DIST. VOLTS (distributor volts) for checking distributor resistance under static conditions. For pinpoint tests, the DC Voltage reading may be switched to ohms (and back to volts) by pressing the VOLT/OHM key successively.

Optional test measurements include amps, magnetic timing, vacuum coil (+), HC, CO, CO_2, 0_2 or HC and CO. If the mag timing probe is used, the strobe timing line automatically switches to mag timing on the page. Vacuum is normally displayed in inches of mercury (HG), but may be displayed in millibars (MBAR) when a service adjustment is performed. If an option is not installed, NOT ACTIVE will appear next to the test measurement.

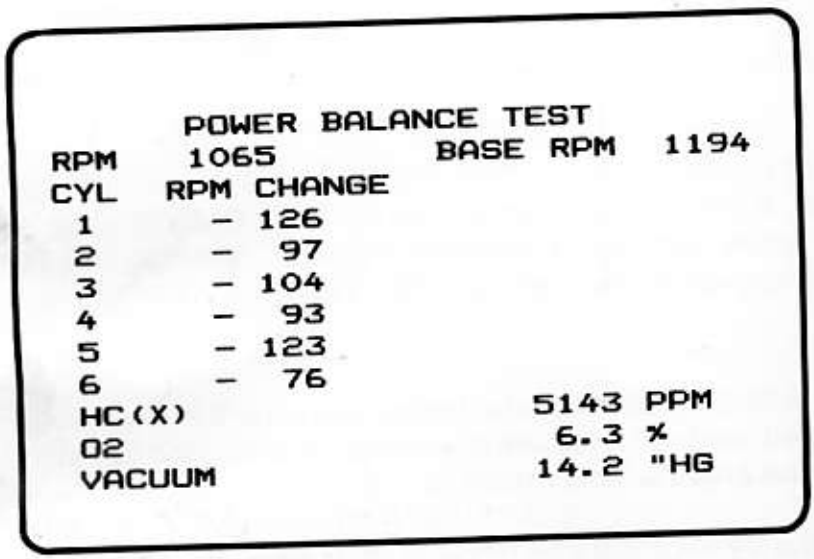


Figure 8. This page has help messages that detail how to prepare the vehicle for power balance tests and how to perform them. The HC, O_2 and Vacuum appear only when manual power balance tests are performed. The HC channel is displayed with an (X), for extended range, to indicate that readings are displayed above the normally standard maximum range of 2000 ppm.

Selection #3: Power Balance

The POWER BALANCE TEST page (Figure 8) is used to perform either an automatic power balance or a manual power balance. In the automatic power balance, each cylinder is shorted out automatically in firing order sequence and an individual RPM CHANGE reading is displayed.

In the manual power balance, cylinders may be selectively shorted while displaying corresponding RPM changes. The RPM CHANGE displayed is the difference between the displayed BASE RPM reading and the active RPM reading.

When the emissions and vacuum options are installed, HC, O_2 and VACUUM readings will appear during manual power balance tests. The changes in these measurements may be observed when individual cylinders are shorted out. Refer to "Test Procedures" for power balance instructions.

Selection #4: Perform Calibration

One of two pages will appear when this menu selection is made.

a. If an emissions module **is not** installed, the CALIBRATION page (Figure 9), identical to the one that appears after the tester self-test/warm-up page, will be displayed. Refer to "Test Preparation" for instructions on how to automatically self-calibrate the analyzer.

b. If the emissions option **is** installed, a CALIBRATION MENU page (Figure 10) will be displayed. The menu contains four selections which detail gas calibration procedures. The CALIBRATION page discussed above is the first selection. Refer to "Maintenance and Service" for details on gas calibration.

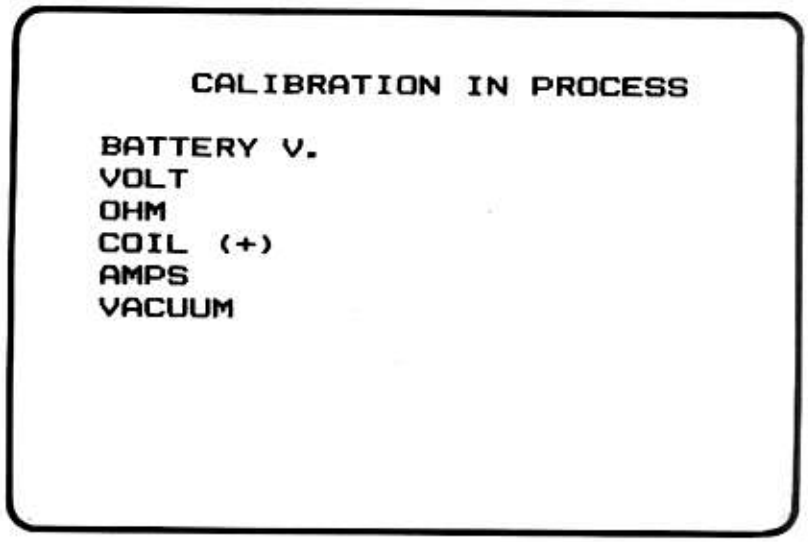


*Figure 9. If an emissions module is **not** installed, this page appears when selection four is made on the PROGRAM MENU page.*

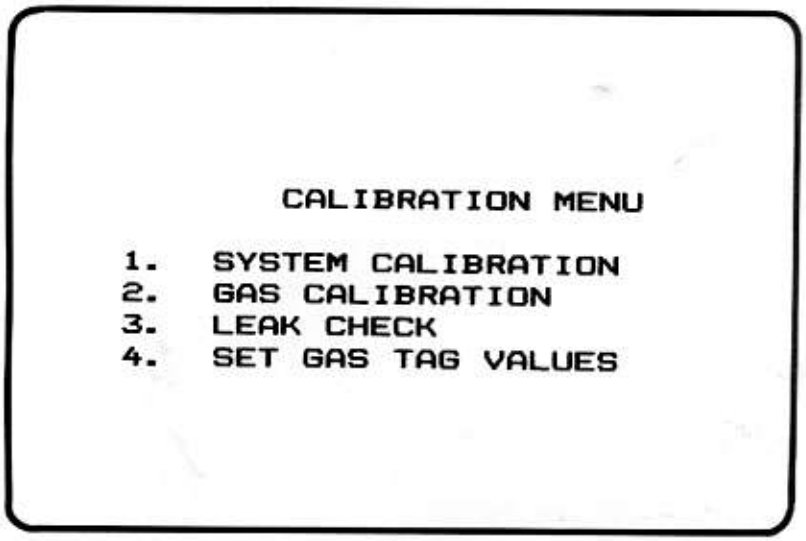


Figure 10. If an emissions module is installed, this page appears when selection four is made on the PROGRAM MENU page.

Oscilloscope

The scope (Figure 11) is capable of displaying primary and secondary circuit patterns, in display, raster and superimposed modes of waveform display. A five millisecond time sweep and a special waveform mode may also be selected.

When the scope is in the display mode, individual cylinder waveform(s) may be expanded and positioned at the millisecond scale line by pressing the cylinder's corresponding key number.

With the exception of front-panel adjustment controls for scope brightness, position, and spacing, the scope is operated entirely with the remote control. Anytime a scope control key is pressed, the setting will appear for a short time in reverse video at the bottom of the VDU (Figure 12).

Refer to "Instruments and Controls" and "Test Procedures" for detailed information on scope operation and testing.

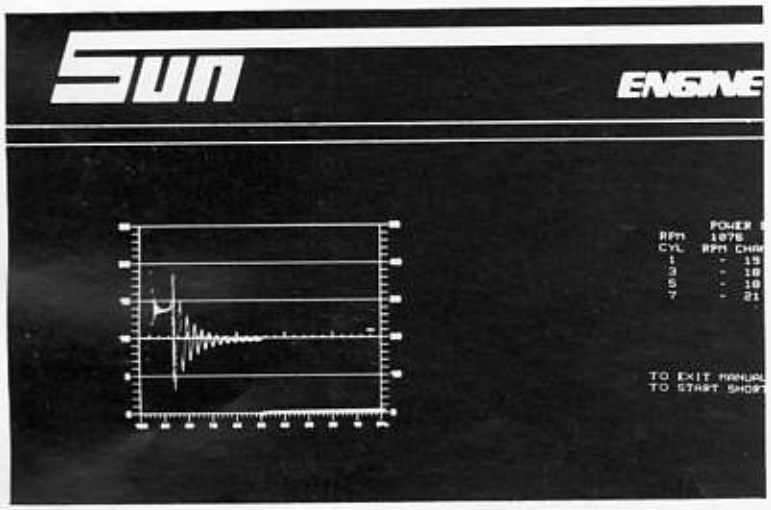


Figure 11 shows a 5 MSEC time sweep. The other available modes of waveform display are display, raster, superimposed and special. The scope is operated with the remote control.

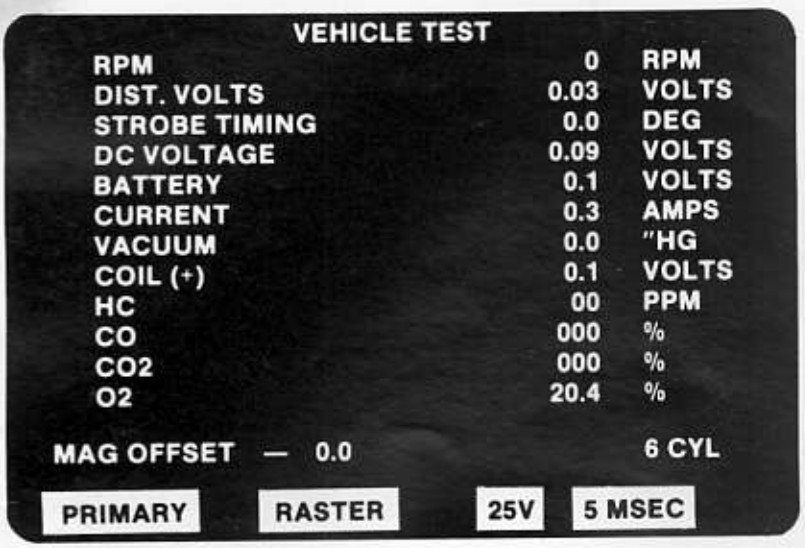


Figure 12. Scope settings appear for a short time in reverse video on the VDU.

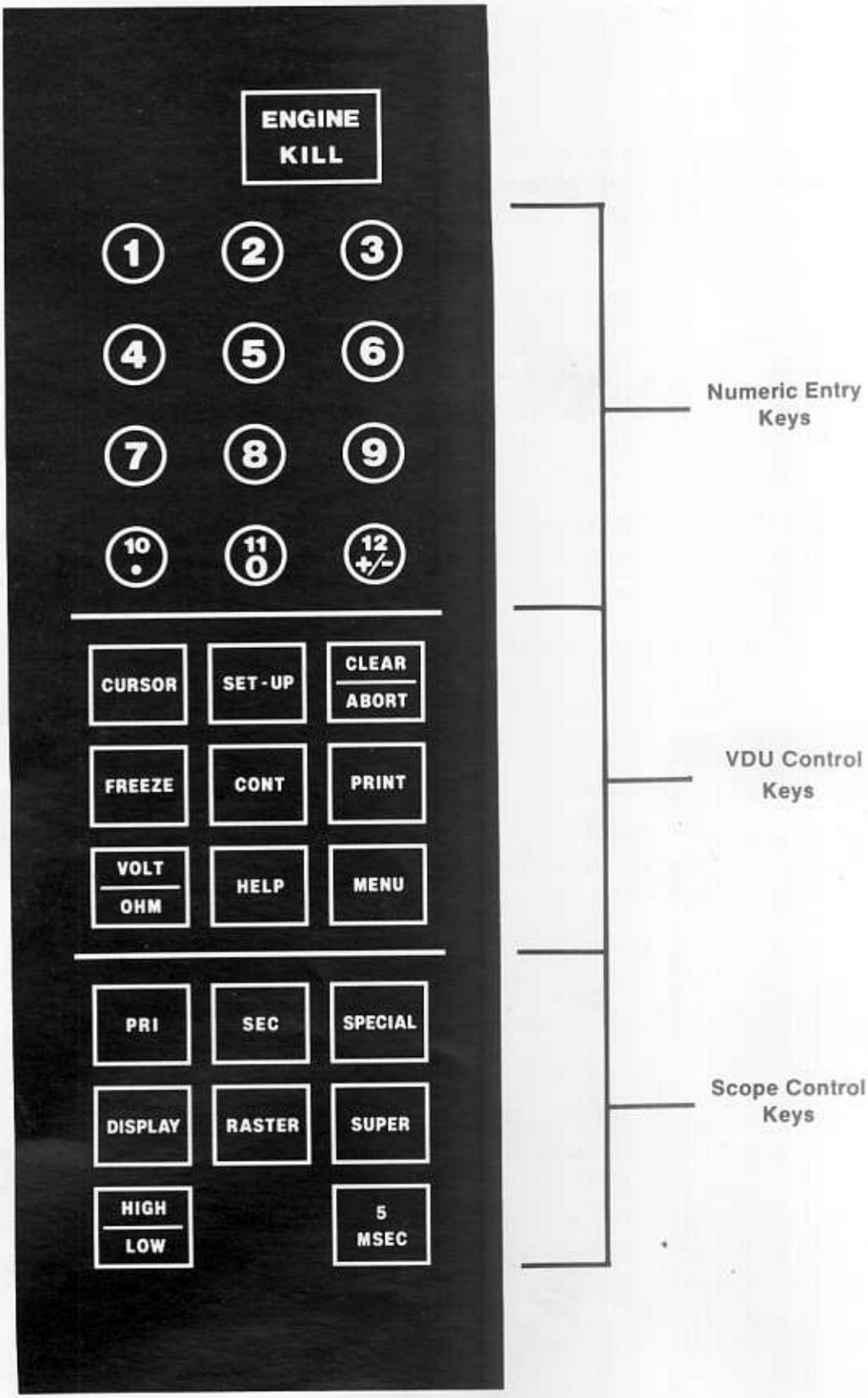


Figure 13. Remote Control

CONTROLS

REMOTE

The remote control keypad (Figure 13) is divided into three basic sections: numeric entry, VDU control, and scope control. An engine kill key is located in the upper right hand corner of the remote control.

ENGINE KILL — Press this key to electronically disable the engine (i.e. in emergency situations to stop the engine or to perform cranking tests). Press again to release. When ENGINE KILL is on, a status indicator will be displayed on the VDU.

Numeric Entry Keys

Numeric entry keys are used to make menu selections, enter numerical data, and to select a specific cylinder (i.e. for power balance or scope display). The function of the key depends on the page displayed. For example, a numeric key pressed on a power balance page will short out a cylinder. On the VEHICLE TEST page, a numeric key pressed will select a cylinder for expanded view on the scope.

NOTE: The ten (10), eleven (11) and twelve (12) functions cannot be used for numeric entries. For example, a number of cylinder entry for a 12 cylinder car is accomplished by pressing "1" then "2".

1 — 9 Press these keys to make number entries and select cylinders.

10 . Dual-function. Use the decimal point with numeric entry keys on the data entry pages; press "ten" to select the number (i.e. cylinder selection on scope control or power balance page).

11 0 Dual-function. Use the zero with numeric entry keys on the data entry pages; press "eleven" to select the number (i.e. cylinder selection on scope control or power balance page).

12 +/- Dual-function. Select plus or minus sign by pressing this key successively when required on data entry pages. Press "twelve" to select the number (i.e. cylinder selection for scope control or power balance page).

VDU Keys

VDU control keys are used to change VDU pages; to clear, print or freeze VDU data; and to select VDU pages (HELP, MENU or SET-UP).

CURSOR Press this key on data entry page to move the cursor down the page to the next data entry line. The cursor will automatically return to the top of the page after last data entry line is cursored past.

SET-UP Press this key to advance directly to the VEHICLE SET-UP page from any other page.

CLEAR / ABORT Press this key to erase data prior to repeating tests or to clear a data entry field.

FREEZE Press this key to stop the automatic update of data on the VEHICLE TEST page and "freeze" the data for analysis. Pressing FREEZE a second time reactivates the screen and discontinues the status indicator on the VDU.

CONT Press the continue key when prompted. It is typically used to leave a test page, start a test, or return from HELP or VEHICLE SET-UP pages.

PRINT Dual function.

1) To print out any individual data page, press the key ONCE. There will be momentary pause before the printer begins to print out the information which appears on the VDU page, except the prompt messages at the bottom.

2) To form feed the printer paper to the next top of form (perforation), press this key TWICE in rapid succession. Refer to the printer operation section for instructions on setting the top of form.

VOLT / OHM Press this key successively to change the display of VOLTS to OHMS and back again on the VEHICLE TEST page.

HELP Press this key for help in setting up the vehicle, setting up the tester or operating the tester. Refer to the "Overview" for more details.

MENU Press this key to return to the previous MENU page.

Scope Keys

The scope control keys are used to select the type of waveform display and the scale to be read. Once selected, these settings are displayed for a short period of time at the bottom of the VDU.

NOTE: Upon power-up, the scope is automatically pre-set to display a primary circuit waveform in the display mode and high scale range.

PRI Press this key to display a PRIMARY circuit waveform on the scope.

SEC Press this key to display a SECONDARY circuit waveform on the scope.

SPECIAL Press this key to display an alternator output waveform (signaled from Red battery (+) lead) on the scope.

DISPLAY Press this key to display all the cylinder waveforms in a horizontal row across the scope. The number one cylinder spark line is displayed at the left of the scope with the remainder of the cylinder waveforms displayed in firing order sequence from left to right. The display will end with the firing line of the number one cylinder on the right. By pressing the appropriate key, a secondary or primary DISPLAY waveform may be viewed on the scope. Figures 14 and 15 show examples of these waveforms.

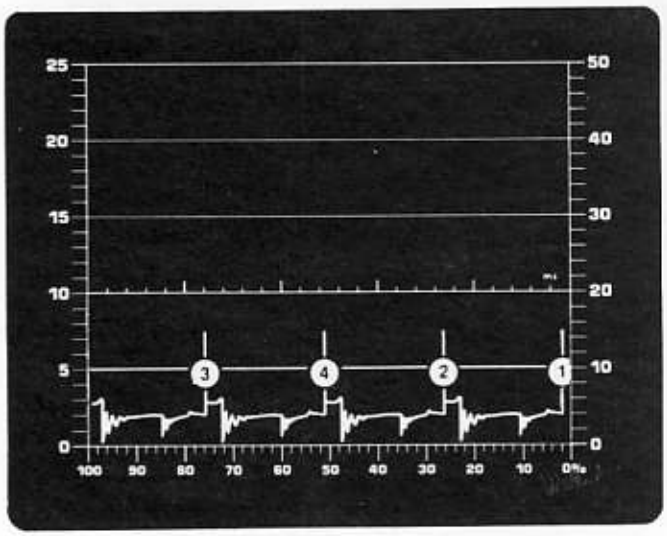


Figure 14. Secondary Display Pattern (Engine firing order 1-3-4-2).

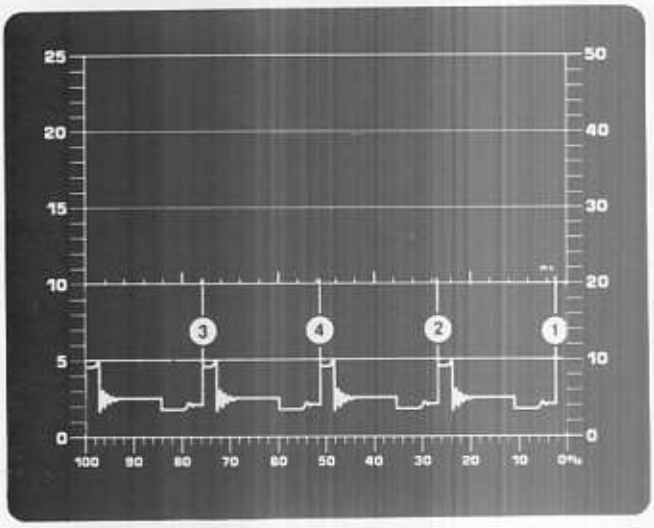


Figure 15. Primary Display Pattern (Engine firing order 1-3-4-2).

Cylinder Select

In the DISPLAY mode, the operator may press a cylinder's number on the remote control and display that cylinder in an expanded sweep above the other cylinders. The cylinder selected will be increased in size and appears in the center of the scope. Pressing the selected keypad number again returns that cylinder's waveform back into the original firing sequence.

One or more cylinders at a time can be selected. Patterns are then overlayed, similar to SUPERIMPOSED. Pressing the DISPLAY key cancels the cylinders chosen and returns the waveforms to the original firing sequence. Figures 16 and 17 show examples of secondary and primary waveforms with cylinders selected.

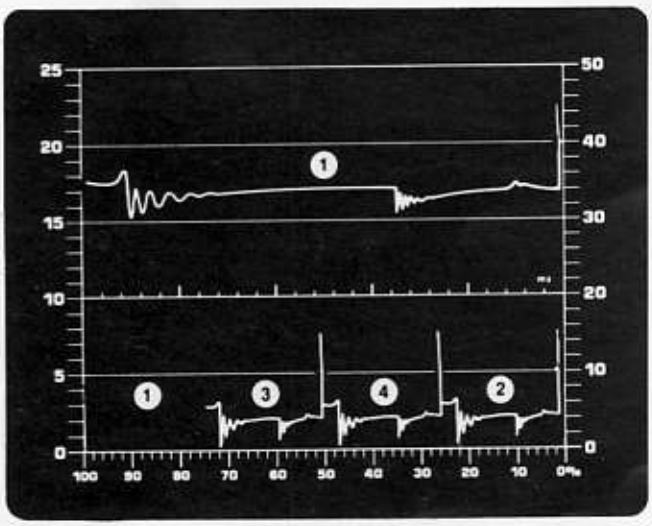


Figure 16. Secondary Display Pattern with Cylinder No. 1 selected. (Engine firing order 1-3-4-2).

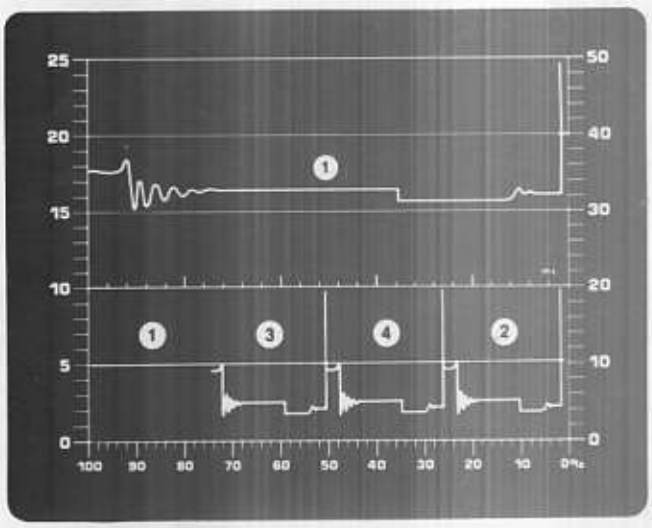


Figure 17. Primary Display Pattern with Cylinder No. 1 selected. (Engine firing order 1-3-4-2).

RASTER

Press this key to display each cylinder waveform one above the other at full screen width. A RASTER display consists of the cylinder number one waveform displayed at the bottom of the scope with the other waveforms displayed one above the other in firing order sequence. By pressing the appropriate key on the remote, a secondary or primary RASTER waveform may be viewed on the scope. Figures 18 and 19 show examples of these waveforms.

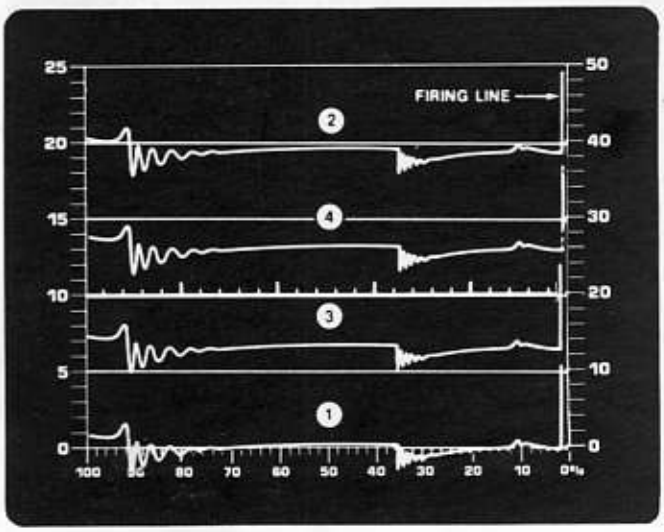


Figure 18. Secondary Raster Pattern

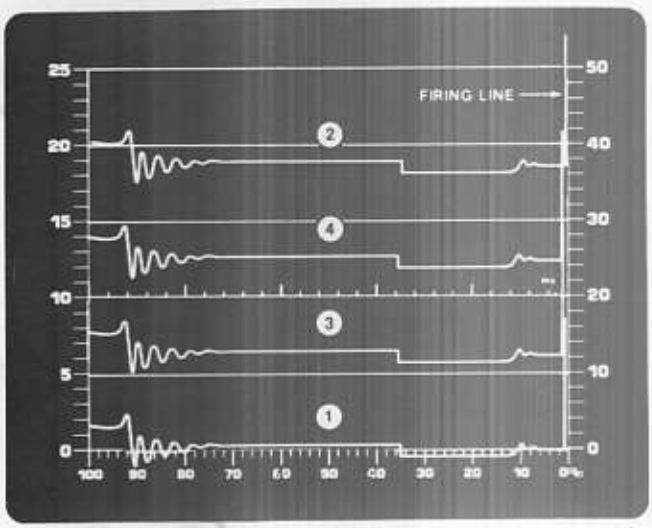


Figure 19. Primary Raster Pattern

The raster spacing control on the front panel (See "Controls") can be used to change spacing between individual cylinders. Individual cylinder select is not available in this mode.

Pressing the SPECIAL key in the RASTER mode displays an alternator output pattern on the scope. Figure 20 shows an example of this waveform.

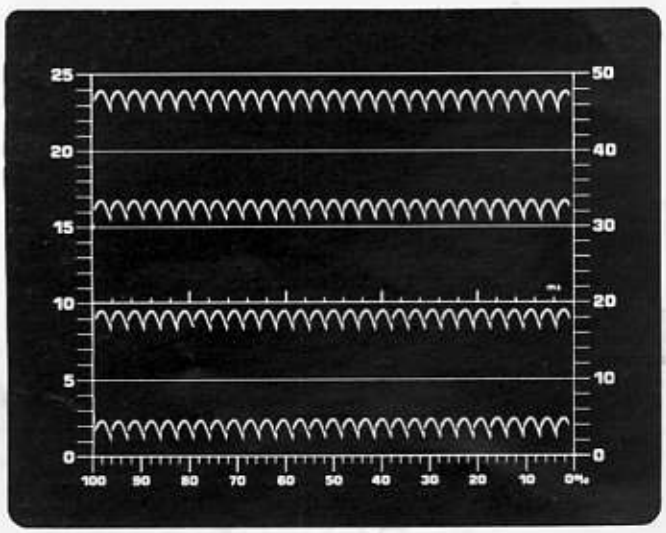


Figure 20. Alternator Raster Pattern

SUPER

Press this key to display a SUPERIMPOSED pattern, which places all the cylinder waveforms one on top of the other. By pressing the appropriate key, a secondary or primary SUPERIMPOSED pattern may be viewed on the scope. Figures 21 and 22 show examples of these patterns.

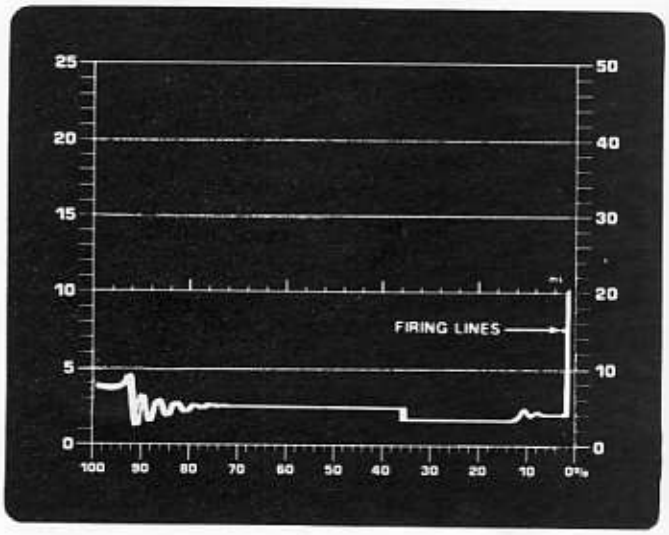


Figure 21. Primary Superimposed Pattern

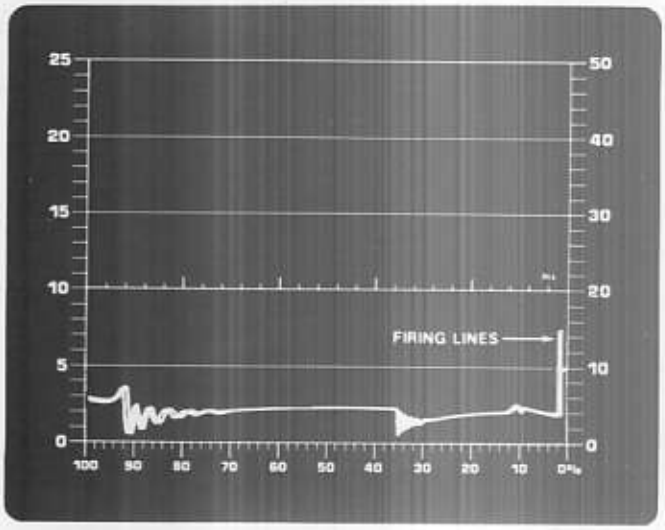


Figure 22. Secondary Superimposed Pattern

5 MSEC

Press this key to display the first five milliseconds of the waveform selected.

In DISPLAY mode, the cylinder select feature is used with the 5 MSEC sweep to show the first five milliseconds of the selected cylinder. Refer to Figure 23 for an example. In RASTER and SUPERIMPOSED modes, **all** cylinders will be displayed with the five millisecond sweep rate.

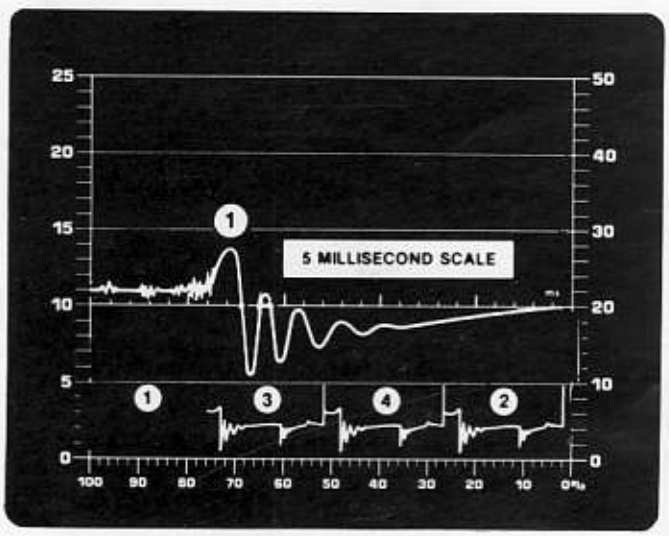


Figure 23. 5 MS Sweep with Cylinder No. 1 selected

HIGH
LOW

Press this key successively to change the range of the displayed scope pattern. The selection made will appear in reverse video on the VDU.

Primary circuit waveforms are displayed in either 0 to 500 volts using the right scale, or 0 to 25 volts using the left scale.

Secondary circuit waveforms are displayed in either 0 to 50 kilovolts using the right scale or 0 to 25 kilovolts using the left scale.

Refer to the "Scales" section for more details.

FRONT-REAR PANEL CONTROLS and SCALES (Figure 24)

Operational

Basic operational controls on the front and rear of the unit include:

Rear

1. ON/OFF SWITCH—Three-position switch (Tester ON — Tester OFF — Light ON) on tester rear panel is used to power tester and turn the head sign light on.

2. VEHICLE GROUND POLARITY SWITCH—Two-position switch (Negative Ground/ Positive Ground) located on the rear panel. Be sure switch is in proper position before testing ("positive" for positive ground systems and "negative" for negative ground systems). Most vehicles are negative ground.

3. PUMP—Two-position switch (Operate/Gas calibrate) on rear panel above the filters. Turn this switch to OPERATE when testing with the optional emissions package to extend pump and filter life. Turn off when not in use.

Front

4. ENGINE KILL—Momentary switch on analyzer front panel duplicates the engine kill function on the remote.

Front Panel Scope Adjustments

The following controls on the tester front panel are used to adjust scope patterns:

5. -☼- BRIGHTNESS—adjusts the intensity of the pattern shown on the scope.

6. ↔ HORIZONTAL POSITION—adjusts the position of the pattern on the scope, left to right.

7. ↕ VERTICAL POSITION—adjusts the position of the pattern on the scope, up or down.

8. ⊢→ SWEEP LENGTH—adjusts the horizontal length of the pattern.

9. RASTER SPACING—adjusts the spacing of the individual cylinder patterns, when the RASTER display is selected.

Scope Scales

The scope displays ignition and charging system waveforms on all test pages and utilizes three scales to measure voltage and dwell in the primary and secondary circuits. The four scales are:

10. 0 to 25 VERTICAL-LEFT SCALE. The 0 to 25 vertical-left scale is divided into increments of 1 kilovolt with a range of 0 to 25 KV (1 KV = 1000V) for secondary circuit testing. When testing the primary circuit, the scale is divided into increments of 1 volt with a range of 0 to 25V.

    This scale is to be used if "25V" or "25KV" is displayed in reverse video on the VDU after making a LOW selection on the remote control.

11. PERCENT OF DWELL SCALE. The percent of dwell scale is divided into 50 increments of two percentage points from 0 to 100.

12. 0 to 50 VERTICAL-RIGHT SCALE. The 0 to 50 vertical-right scale is divided into increments of 2 kilovolts with a range of 0 to 50 kV for secondary circuit testing. When testing the primary circuit, the scale is divided into increments of 20 volts with a range of 0 to 500v. (1KV = 1000v).

    This scale is to be used if "500V" or "50 KV" is displayed in reverse video on the VDU after making a HIGH selection on the remote control.

13. MS SCALE. The millisecond (MS) scale is divided into five major increments each representing 1 millisecond. Each of the five major divisions are further divided into 5 smaller increments each representing 0.2 of a millisecond (millisecond = 1/1000 of a second).

    The 5 MSEC scale is selected by pressing the 5 MSEC key on the remote control.

TEST PREPARATION

Self-Test/Warm-up

1. Plug the tester power cord into the proper power outlet. See the nameplate on the tester for power requirements.

2. Push the three-position AC power switch (tester ON, tester OFF, light ON) to the tester ON position (Figure 24). A title page (Figure 25), with a copyright notice and software version number, will be displayed upon power-up.

3. If the printer option is installed, align the paper perforation with the cutting edge of the printer cover by turning the platen knob.

4. Press CONT to display the Self-Test/Warm-up page (Figure 26). The analyzer will then perform an automatic self-test with the message SELF TEST OK appearing if no problems are sensed. If a system fault is detected, a message describing the fault appears.

5. If the 4-gas option is installed, a 15-minute warm-up timer will be displayed. If the CONT key is pressed before the warm-up is complete, the tester will calibrate all items except HC, CO, and CO_2. Testing of the vehicle may begin, but readings of these gases will not appear. Repeating the calibration process fifteen minutes later will allow gases to calibrate.

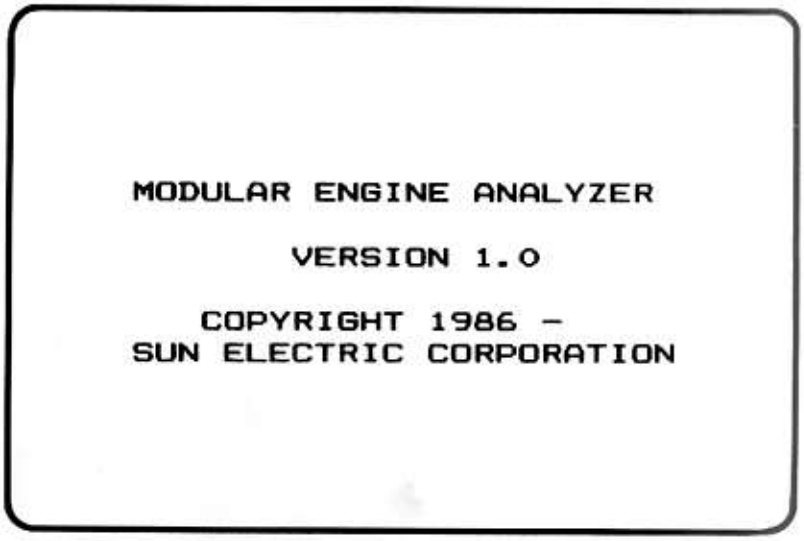


Figure 25. This is first page the operator will see after the MEA-1500 is turned on.

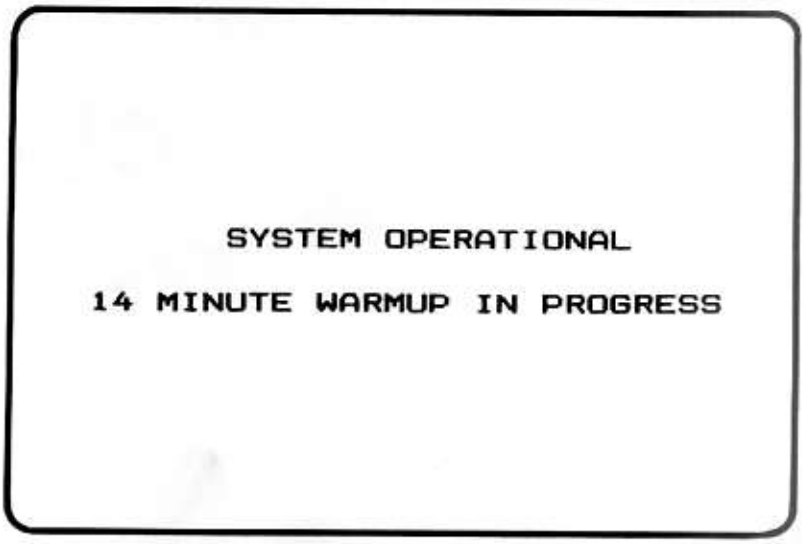


Figure 26. "System Operational" means the analyzer has passed its self-test and everything is in working order. The warm-up timer only appears if the emissions module is installed.

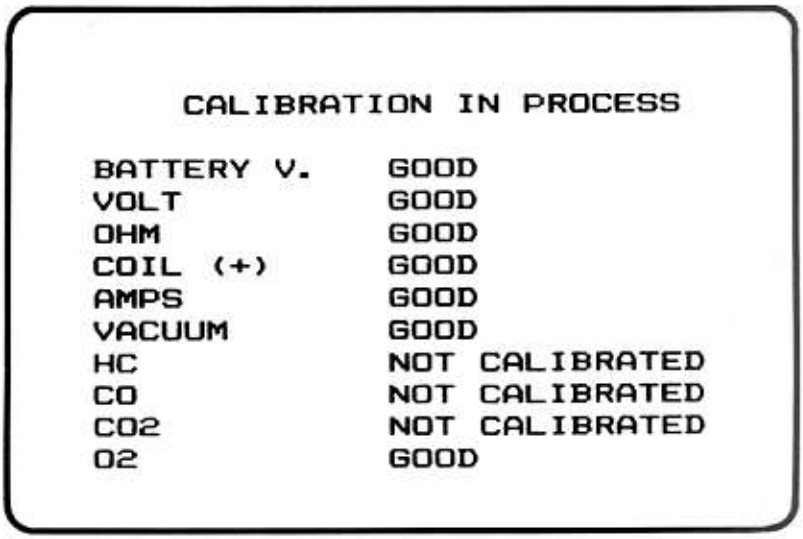


Figure 27. "Good or "Service Required" or "Not Calibrated" will appear next to each item as the MEA electronically calibrates itself. The HC, CO and CO_2 readings will not calibrate until the 15-minute warmup is complete.

Calibration

5. Press the CONT key. The CALIBRATION page (Figure 27) will be displayed. Short the volt-ohm leads together (reference Figure 29). The message SHORT VOLT/OHM leads will flash on and off on the VDU until this is done. Do not attempt tester calibration while the test leads are attached to a vehicle. Incorrect calibration will result. (Optional items not installed will not be displayed on this page.)

6. The tester will automatically self-calibrate all items displayed in Figure 27, displaying GOOD or SERVICE REQUIRED next to each parameter. The calibration may be re-started at any time by pressing the CLEAR/ABORT key.

7. When calibration is complete, the message PRESS MENU or CONT will appear at the bottom of the VDU.

Vehicle Setup

8. The tester is automatically set up for 4-cylinder, 4-cycle engines with 0.0 magnetic offset angle. If these set-up specifications do not need to be altered, the operator may proceed directly to the VEHICLE TEST page by pressing the CONT key. If the vehicle set-up does need to be changed, the operator may select the VEHICLE SET-UP page (Figure 28) by pressing the SET-UP Key.

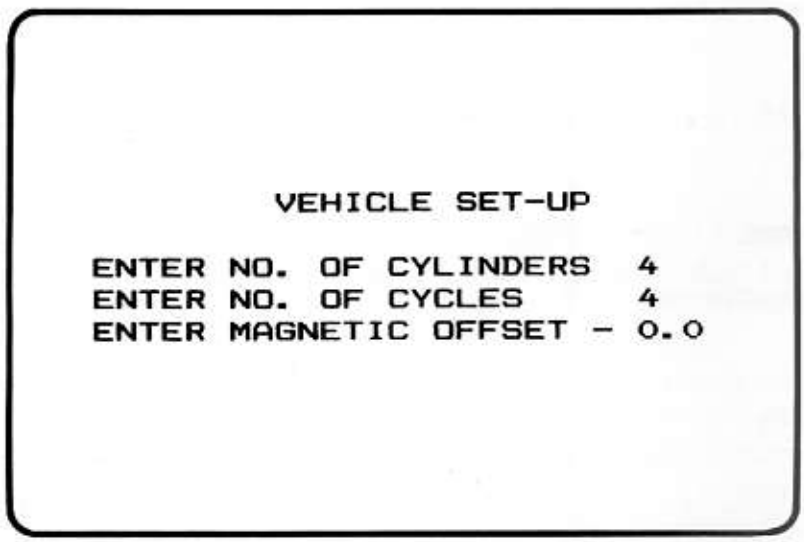


Figure 28. The MEA-1500 is automatically preset for these vehicle specifications.

To change the test parameters, press the CURSOR key to advance the cursor to the data line which is to be changed, then press the CLEAR/ABORT key. Enter the new data using the numeric keys. If the entry flashes on the screen, it is out of limit. Check the number and re-enter.

Lead Connections

9. Connect the test leads with the **engine off** (Figure 29) as follows:

   a. If the vehicle being tested is equipped with a magnetic timing probe receptacle, install the mag probe in the receptacle, with adapter if required. Refer to "Accessories".

   b. If the vehicle does not have a mag probe or the magnetic timing option is not installed, check timing with the timing light. Clean the crankshaft pulley and timing pointer. Use a piece of chalk or white touchup paint to paint the Zero Degree Line on pulley and pointer for visibility.

   c. Turn the timing advance knob on the timing light fully counterclockwise (off) until it clicks. Then place the on/off button in the "off" position (white dot out).

   d. Clamp the BLUE—booted primary connector to the TACH or (-) coil terminal.

   e. If coil (+) option is installed, clamp the YELLOW-booted connector (BLACK twinflex lead) to the positive terminal of coil. Both the coil (-) and coil (+) connectors will be part of a single BLACK twinflex lead.

   f. Clamp the CHROME pattern pickup (BLUE lead) around the coil high-tension wire.

      NOTE: If system does not have a coil high-tension wire, Sun options are needed, for example, the HEI adapter. Refer to "Accessories".

   g. Clamp the RED-booted connector (BLACK twinflex lead) to the positive battery terminal.

   h. Clamp the BLACK-booted connector (BLACK twinflex lead) to the negative battery terminal.

   i. If the vacuum/amps option is installed, clamp the GREEN ammeter pickup around the negative battery cable (around all wires if there is more than one) with the arrow on the pickup pointing away from the battery.

   j. Clamp the RED trigger pickup (RED lead) around the number one spark plug as close to the distributor cap as possible.

   k. If the vacuum/amps option is installed, connect the vacuum hose to a direct source of engine vacuum. Do not connect to any other source such as ported vacuum or vacuum reservoir.

   L. If an emissions module is installed, disable the air pump to prevent catalytic converter action by clamping or pinching off the hoses or tubes at the air pump or engine. Some manufacturers recommend disconnecting and plugging the tubes leading from the air pump. Consult each manufacturer's specific recommendations.

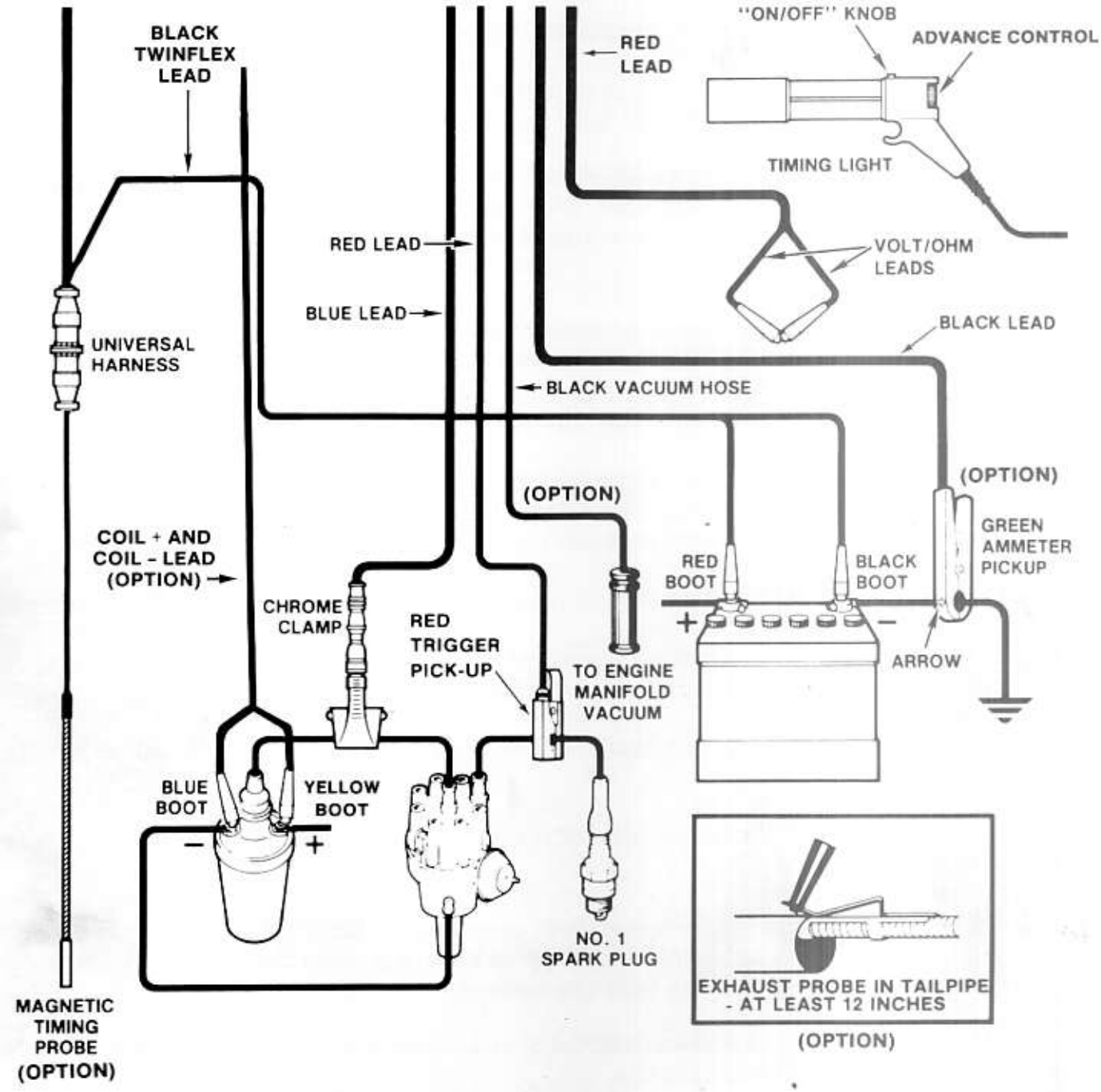


Figure 29. Tester Hookup to Vehicle

NOTE: If the coil (+) option is not installed, a single BLUE primary lead will be substituted.

1. Disable Pulse-Air systems to prevent catalytic converter action by plugging tubes at the air cleaner. Be sure to close off any air supply to the catalytic converter.

   NOTE: To prevent damage to air pump, close off hose after diverter valve.

2. Insert the sampling probe into the tailpipe, at least 12 inches.

3. Connect exhaust ventilation to the tailpipe.

4. Turn the two-position pump switch on the back of the tester to the OPERATE position.

m. Turn all vehicle accessories off.

n. Place the vehicle shift lever in PARK if it has an automatic transmission and set the parking brake; on vehicles with manual transmissions, place the shift lever in NEUTRAL and set the parking brake.

TEST PROCEDURES

The following section details a variety of tests which can be performed using the VEHICLE TEST page, the POWER BALANCE TEST page and the ignition oscilloscope. The tests may be used selectively to check for suspected problems or in their entirety to check overall engine performance.

STANDARD TEST PROCEDURE

The standard test procedure is a suggested sequence of engine tests performed under various operating conditions, including:

1) Key-off, engine-off
2) Key-on, engine-off
3) Cranking
4) High cruise
5) Low cruise
6) Idle
7) Snap acceleration
8) Power balance

The tests above are described on the following pages for both standard and optional MEA-1500 test capabilities. Be sure to note the capabilities of your MEA-1500 before proceeding with the tests.

1. Key-Off, Engine-Off Tests

CHECK BATTERY VOLTAGE AND CURRENT DRAW AS FOLLOWS:

a. Turn the engine off, close all the doors and turn off all the accessories.

b. Note the readings. The shaded areas on Figure 30 indicate which lines should be read.

c. If desired, press the PRINT key to record the results.

Test Mode	Test	Read	Test Indications — Good
Engine Off	Battery	VDU	12.4V or higher for 12-volt systems
Key Off	Current	VDU	Near 0

```
          VEHICLE TEST
RPM                        0   RPM
DIST. VOLTS             0.08   VOLTS
STROBE TIMING            0.0   DEG
DC VOLTAGE              0.00   VOLTS
BATTERY                 12.0   VOLTS
CURRENT                  0.0   AMPS
VACUUM                   0.0   "HG
COIL (+)                 0.2   VOLTS
HC                        18   PPM
CO                      0.00   %
CO2                     0.02   %
O2                      20.7   %

MAG OFFSET  -   9.5          6 CYL
```

Figure 30. For the engine-off, key-off tests, read the fifth and sixth lines of the VDU.

2. Key-On, Engine-Off Tests

CHECK BATTERY VOLTAGE, CURRENT DRAW, COIL (+) AND DIST. VOLTS AS FOLLOWS:

a. Turn the ignition key to on, but do not start the engine.

b. Note the readings. The shaded areas on Figure 31 indicate which lines should be read.

c. If desired, press the PRINT key to record the results.

Test Mode	Test	Read	Test Indications — Good
Engine Off Key On	Dist. Volts	VDU	Depends on vehicle type
	Battery	VDU	12 Volts or higher
	Current	VDU	Depends on vehicle type
	Coil (+)	VDU	Close to battery voltage

```
          VEHICLE TEST
RPM                        0   RPM
DIST. VOLTS             5.86   VOLTS
STROBE TIMING            0.0   DEG
DC VOLTAGE              0.00   VOLTS
BATTERY                 11.9   VOLTS
CURRENT                  7.1   AMPS
VACUUM                   0.0   "HG
COIL (+)                11.1   VOLTS
HC                        15   PPM
CO                      0.00   %
CO2                     0.01   %
O2                      20.7   %

MAG OFFSET  -   9.5          6 CYL
```

Figure 31. The Dist. Volts reading on the second line only appears when RPM is 0.

3. Cranking Tests

NOTE: Perform cranking tests under no-start and hard-start conditions. Where possible, the ENGINE KILL button should be used to prevent the engine from starting.

PERFORM CRANKING TESTS AS FOLLOWS:

a. If the engine is carbureted and the emissions module is installed, pump the accelerator once to insure that some fuel enters the engine to be sensed at the tailpipe. If the engine diesels, let the engine cool or pump the accelerator pedal several times before repeating the test.

b. Crank the engine until the test data stabilizes, but no longer than 15 seconds at a time.

c. If desired, press the FREEZE key to hold the cranking readings for analysis, or press PRINT to record them while the engine is cranking.

d. The shaded areas on Figure 32 indicate which lines should be read.

NOTE: If the four-gas option is installed, the appearance of LOW FLOW or PUMP OFF messages indicate that certain conditions should be corrected before proceeding. Turn the switch above the filters to the OPERATE position, or refer to "Maintenance And Service" to correct low flow.

Test Mode	Test	Read	Test Indications — Good
Cranking	RPM	VDU	Min. 140-300 (4 cyl.), 130-230 (6 cyl.), 120-200 (8 cyl.)
	Dwell	VDU	Refer to manufacturer's specifications
	Timing	VDU	Refer to manufacturer's specifications
	Battery	VDU	9.6 Volts or higher
	Current	VDU	Max. 210-280 (8 cyl.), 150-270 (6 cyl.), 120-220 (4 cyl.)
	Vacuum	VDU	1" or above and steady
	Coil (+)	VDU	Close to battery voltage
	HC	VDU	Carbureted — over 1000 Fuel injected — as low as 0

VEHICLE TEST

RPM	214	RPM
DWELL 61.9 %	37.1	DEG
STROBE TIMING	0.0	DEG
DC VOLTAGE	0.00	VOLTS
BATTERY	10.3	VOLTS
CURRENT	- 159	AMPS
VACUUM	5.3	"HG
COIL (+)	9.6	VOLTS
HC	432	PPM
CO	0.40	%
CO2	4.28	%
O2	14.5	%

MAG OFFSET - 9.5 6 CYL

Figure 32. The Dwell reading on the second line appears when RPM is above zero. DC voltage on fourth line is only used for pinpoint tests.

4. High Cruise Tests

PERFORM THE VDU PORTION OF THE HIGH CRUISE TESTS AS FOLLOWS:

a. Accelerate the engine to approximately 2500 RPM (plus or minus 100 RPM) and maintain it for 15 to 20 seconds or until test data stabilizes.

b. If the magnetic timing option is installed, timing will be automatically displayed. The magnetic timing offset angle selected on the VEHICLE SET-UP page will be shown at the bottom of the VDU.

c. If the timing light is used, check the timing advance by setting the on/off switch on top of the timing light to the ON position. Then turn the timing advance control on the timing light clockwise until it clicks on. Point the timing light at the timing pointer, then turn the advance control until the mark on the crankshaft pulley lines up with the ZERO degree mark on the cover.

   NOTE: On engines that have timing degree marks stamped in the timing chain cover, line up the mark on the crankshaft pulley with the ZERO degree mark on the cover.

d. After the above procedure, strobe timing in degrees will appear on the VDU.

e. When test data stabilizes, press the FREEZE key to hold the high cruise readings for analysis, or press PRINT to record them. The shaded areas on Figure 33 indicate which lines should be read.

PERFORM THE SCOPE PORTION OF HIGH CRUISE TESTS AS FOLLOWS:

a. Maintain 2500 RPM test speed while performing these scope tests:

   1. **Alternator Condition**. Set the scope to RASTER mode and SPECIAL waveforms. Note the uniformity of the ripple waveform.

   2. **Firing Voltage.** Set the scope to DISPLAY mode, 25 KV scale, and SEC waveform. Observe the voltage levels of the firing lines.

   3. **Coil Oscillations**. Set the scope to RASTER mode and either PRI or SEC and either scope scale. Look for 4 or more gradually diminishing oscillations in the intermediate section of the waveform.

   4. **Spark Duration**. Set the scope to RASTER mode and 5 MSEC waveform. Note the spark lines.

   5. **Cylinder Timing**. Set the scope to SUPERIMPOSED mode and either PRI or SEC waveform, HIGH or LOW scale. Observe the point open or close signals for variation. On electronic ignition systems, the transistor off signals are to be observed for variation.

Test Mode	Test	Read	Test Indications — Good
High Cruise	RPM	VDU	2400 to 2600
	Dwell	VDU	Refer to manufacturer's specifications
	Timing	VDU	Refer to manufacturer's specifications
	Battery	VDU	13.2 - 15.6
	Current	VDU	5 or greater
	Vacuum	VDU	Higher than idle speed
	HC	VDU	Lower than low cruise HC
	CO	VDU	Lower than low cruise CO
	CO2	VDU	Same as low cruise CO2
	02	VDU	Higher than low cruise
	Alternator	Scope	See "Oscilloscope Testing"
	Firing voltage	Scope	See "Oscilloscope Testing"
	Coil oscillations	Scope	See "Oscilloscope Testing"
	Spark duration	Scope	See "Oscilloscope Testing"
	Cylinder timing	Scope	See "Oscilloscope Testing"

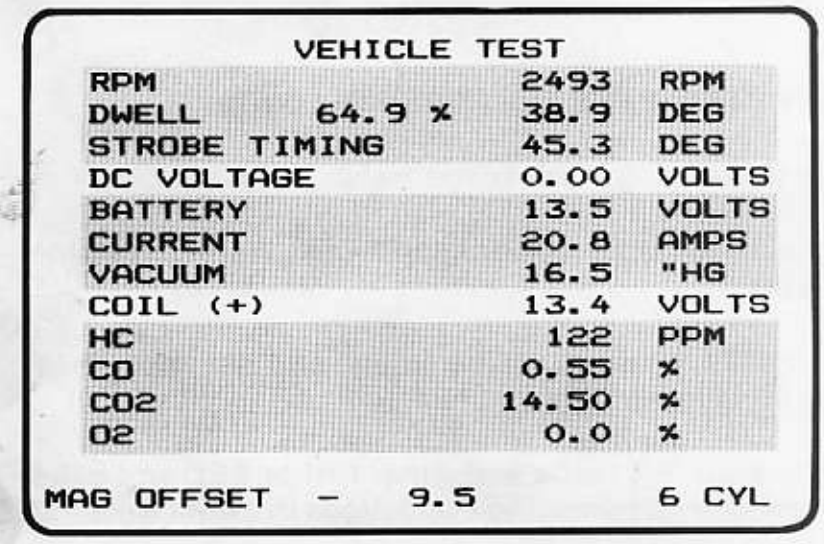


Figure 33. Line three will show a mag timing reading instead of strobe timing if the mag timing option is connected.

5. Low Cruise Tests

PERFORM THE LOW CRUISE TESTS AS FOLLOWS:

a. Accelerate the engine to approximately 1500 RPM (plus or minus 100 RPM) and maintain until HC and CO stabilize.

b. Repeat timing procedures from high cruise test.

c. When test data has stabilized, press the FREEZE key to hold the low cruise readings for analysis, or press the PRINT key to record them. The shaded areas on Figure 34 indicate which lines should be read.

Test Mode	Test	Read	Test Indications — Good
Low Cruise	RPM	VDU	1400 — 1600
	Dwell	VDU	Refer to manufacturer's specifications
	Timing	VDU	Refer to manufacturer's specifications
	Battery	VDU	13.2 — 15.6
	Current	VDU	Greater than 2.5
	Vacuum	VDU	Greater than idle
	HC	VDU	Lower than idle HC
	CO	VDU	Lower than idle CO
	CO2	VDU	Same as idle
	O2	VDU	Higher than idle

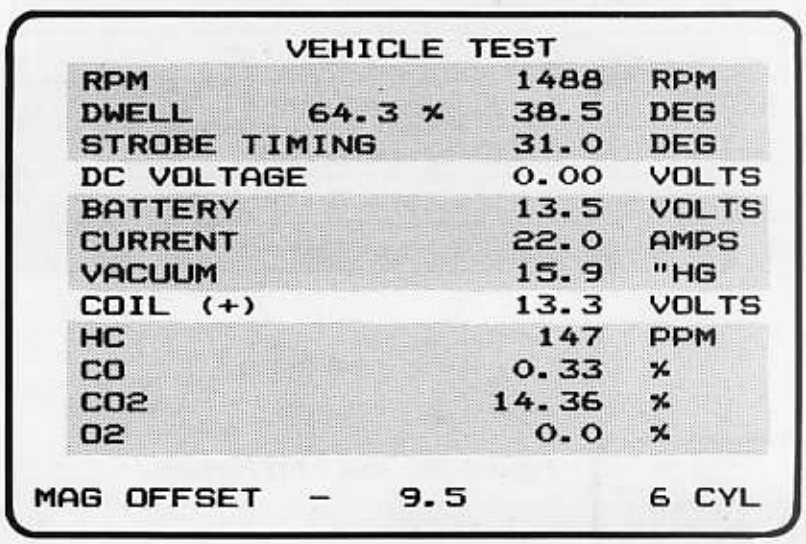


Figure 34. Low Cruise Test Results.

6. Idle Tests

PERFORM THE VDU PORTION OF THE IDLE TESTS AS FOLLOWS:

a. Check the vehicle manufacturer's recommended curb idle speed and set-up conditions and follow the recommended procedure.

b. Check the vehicle manufacturer's initial timing, speed and set-up conditions and follow the recommended procedure.

c. Bring the engine to the vehicle manufacturer's recommended initial timing speed (plus or minus 50 RPM), and repeat timing procedures.

d. When test data has stabilized, press the FREEZE key to hold the idle test readings for analysis, or press PRINT to record them. The shaded areas on Figure 35 indicate which lines should be read.

Perform the same tests which were done for HIGH CRUISE tests to complete the VDU portion of the IDLE tests.

Test Mode	Test	Read	Test Indications — Good
Idle	RPM	VDU	Curb idle per manufacturer's spec.
	Dwell	VDU	Refer to manufacturer's specifications
	Timing	VDU	Initial timing per manufacturer's spec.
	Battery	VDU	13.2 — 15.6
	Current	VDU	Minimum of 2
	Vacuum	VDU	Varies with altitude and vehicle type
	HC	VDU	See Chart
	CO	VDU	See Chart
	CO2	VDU	See Chart
	02	VDU	See Chart
	Coil polarity	Scope	See "Oscilloscope Testing"
	Firing voltage	Scope	See "Oscilloscope Testing"
	Coil oscillations	Scope	See "Oscilloscope Testing"
	Spark duration	Scope	See "Oscilloscope Testing"
	Cylinder timing	Scope	See "Oscilloscope Testing"

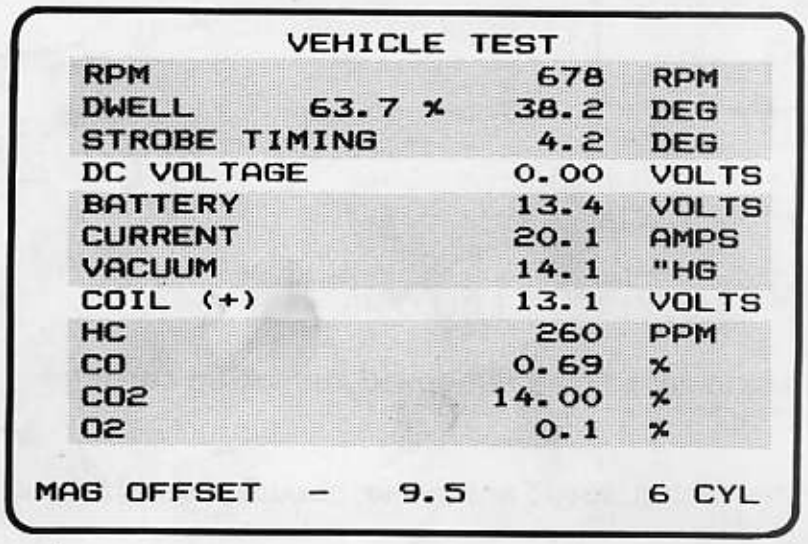


Figure 35. Idle Test Results.

VEHICLE YEAR	HC(ppm) LESS THAN	CO_2(%) GREATER THAN	CO(%) LESS THAN	O_2(%) IN THE RANGE OF
71-75	400 ppm	10%	3%	1%
76-79	300 ppm	11%	2%	2%
80-83	200 ppm	12%	1%	3%
84-86	150 ppm	13%	.5%	4%

7. Snap Acceleration Tests

PERFORM THE SNAP ACCELERATION TESTS AS FOLLOWS:

a. Set the scope to DISPLAY mode, SEC waveform and 25 KV scale.

b. Snap accelerate the vehicle by rapidly pushing the accelerator to the floor and releasing it.

c. Observe the voltage levels of the firing lines on the scope.

d. Press FREEZE to hold the snap acceleration readings for analysis, or press PRINT to record them. The shaded area on Figure 36 indicates which line should be read.

Test Mode	Test	Read	Test Indications — Good
Snap Acceleration	Firing voltage under load	Scope	See "Oscilloscope Testing"
	CO Change	VDU	Minimum increase of 1%

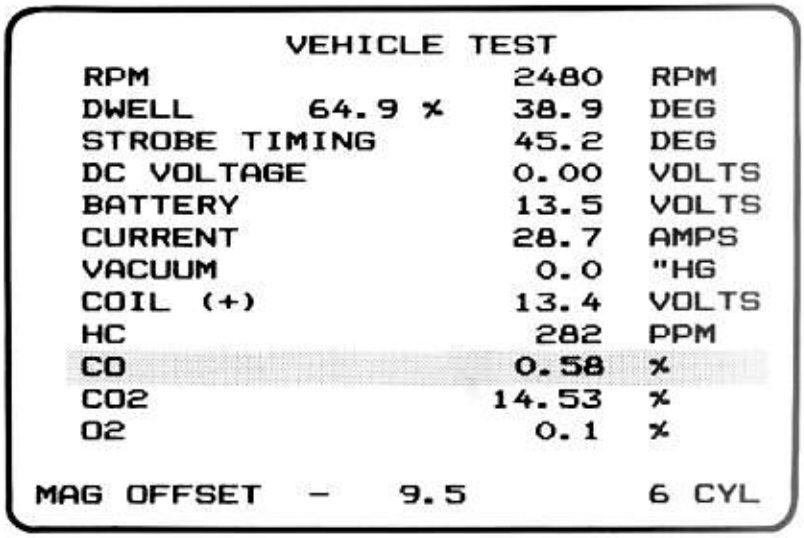


Figure 36. Snap Acceleration Test Results.

8. Power Balance Tests

Return to the PROGRAM MENU by pressing the MENU key, and select power balance tests. The POWER BALANCE test page (Figure 37) will be displayed.

a. Prepare for POWER BALANCE tests.

1. Use a jumper wire to keep the electric cooling fan on during the test
2. Disable RPM and carburetor mixture feedback controls per manufacturer's recommendation.
3. Disconnect and plug the EGR vacuum hose.
4. Stabilize the engine at the desired test speed, not less than 1000 RPM.

NOTE: If the TRIGGER PICKUP NOT SENSED or COIL CONNECTION NOT PRESENT messages appear and "flash" (when engine is running), check the BLUE primary lead and RED trigger pickup for proper connections.

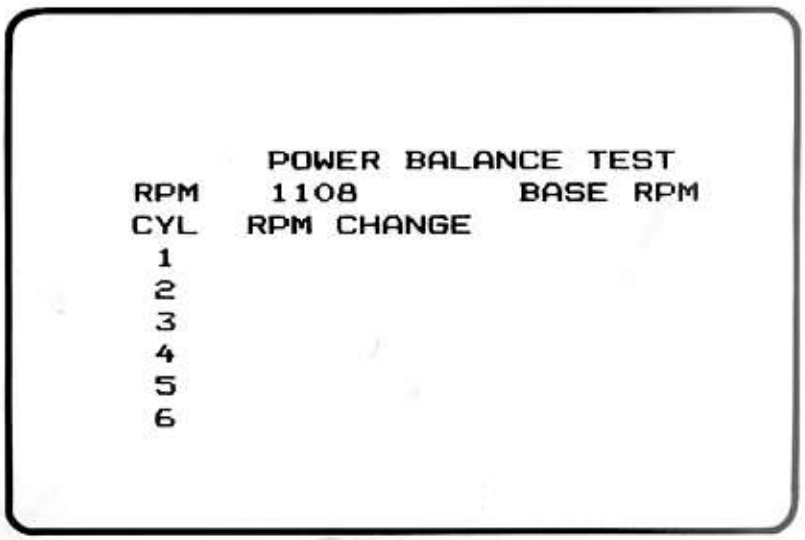


Figure 37. Help messages that detail how to prepare the vehicle for power balance tests are available for this page.

b. Either an automatic or a manual power balance test can be performed from the POWER BALANCE TEST page.

1. To perform an automatic power balance test, press the CONT key. The analyzer will automatically short out one cylinder at a time. The difference between RPM before shorting (BASE RPM) and RPM when shorted is displayed as RPM CHANGE. A new BASE RPM is computed for each cylinder as it is shorted. The test is complete when data for all cylinders is displayed (Figure 38).

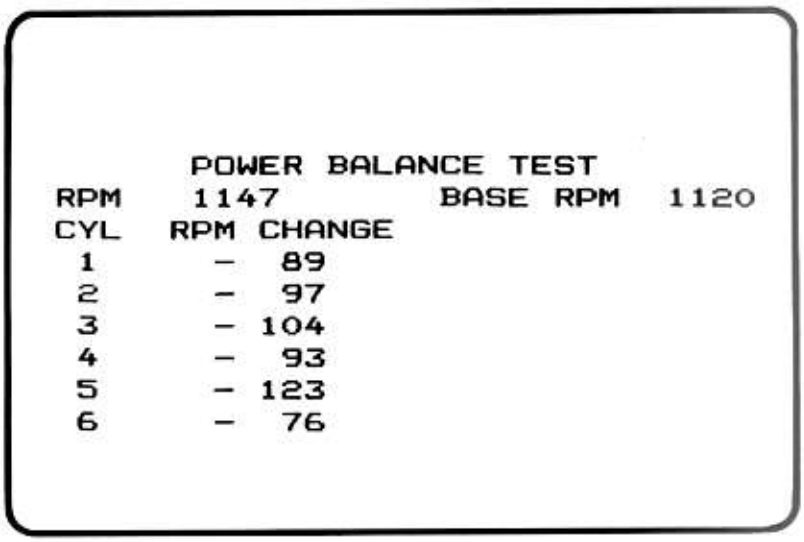


Figure 38. After automatic power balance tests are completed, help is available for performing manual power balance tests.

Power balance test results will remain displayed until they are cleared. It is not necessary to freeze results. If desired, test results may be printed out at any time during manual or automatic power balance tests.

2. To perform manual power balance tests, select the cylinder or cylinders to be shorted by pressing the remote control numeric keys corresponding to the cylinder number(s).

   NOTE: If the automatic power balance tests preceded the manual power balance tests, and the previous data was not cleared, the RPM CHANGE reading from the previous test will be retained until cylinders are shorted manually and new readings are displayed.

3. If a new cylinder is shorted within two seconds of the last cylinder being unshorted, the same BASE RPM will be used to calculate the new RPM CHANGE. If more than two seconds elapse after the last cylinder was unshorted, a new BASE RPM will be used to calculate RPM CHANGE.

   NOTE: When using the second method described above, allow the engine speed to stabilize after the cylinder is shorted out. Do not allow any cylinder to be shorted out for more than 10 seconds, or damage to the catalytic converter may result. To unshort a cylinder, press its corresponding key number a second time. To unshort all cylinders, press the CONT key.

4. If the engine being tested is a carbureted V-6, V-8 or horizontally-opposed engine with a multi-plane intake manifold, perform a fuel balance test.

a. Press the key numbers corresponding to the ODD-numbered cylinders. This will short out the cylinders fed by one carburetor barrel.

b. Allow the engine speed to decrease and stabilize and then press the CONT key to unshort all cylinders. Operate the engine for a few minutes to ailow it to return to normal operation. The total engine speed change will be displayed next to each cylinder which was selected.

NOTE: Do not operate the engine for more than 10 seconds with cylinders shorted.

c. Press the key numbers corresponding to the EVEN-numbered cylinders. This will short out the cyinders fed by the other carburetor barrel. Allow the engine speed to decrease and stabilize, then press CONT.

d. Compare the RPM lost when all ODD cylinders were shorted to that lost when all EVEN cylinders were shorted. The difference should not exceed 30 RPM.

Test Mode	Test	Read	Test Indications — Good
Power Balance	RPM Change	VDU	Even and within 30 RPM from cyl. to cyl.
	Vacuum Change	VDU	Equal from cylinder to cylinder
	HC Change	VDU	Equal from cylinder to cylinder
	O2 Change	VDU	Equal from cylinder to cylinder

```
        POWER BALANCE TEST
RPM     1128          BASE RPM
CYL   RPM CHANGE    CYL  RPM CHANGE
 1      - 352        2      - 344
 3      - 352        4      - 344
 5      - 352        6      - 344
 7      - 352        8      - 344
HC(X)                    432 PPM
O2                      10.7 %
VACUUM                  16.0 "HG
```

Figure 39. HC, 0_2 and vacuum readings appear only with manual power balance tests. HC readings which are over range are marked (X).

PINPOINT TESTS AND VEHICLE ADJUSTMENTS

When the VEHICLE TEST page is displayed the analyzer may be used to perform pinpoint tests using its electrical and emissions testing capabilities. Measurements on the fourth data line of the test page are used exclusively for this purpose. The DC VOLTS measurement may be changed to RESISTANCE and back again by pressing the VOLT/OHM key successively. Volts or ohms may be measured at any point in a vehicle circuit or component with the volt/ohm leads connected.

NOTE: Do not connect the volt/ohm leads to a "live" source.

The VEHICLE TEST page may also be used as a guide for performing various vehicle adjustments, such as dwell, timing, curb idle, and fuel mixture. The continuously updated digital readings on the page will indicate when an adjustment is within specification.

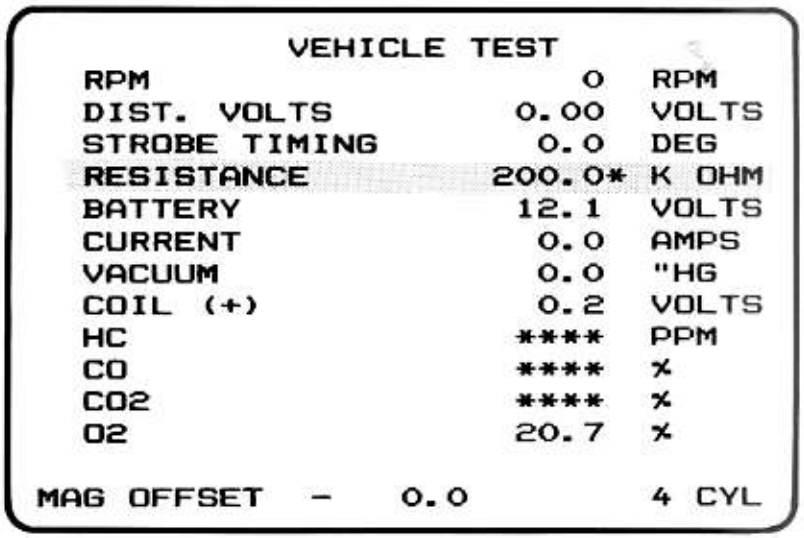


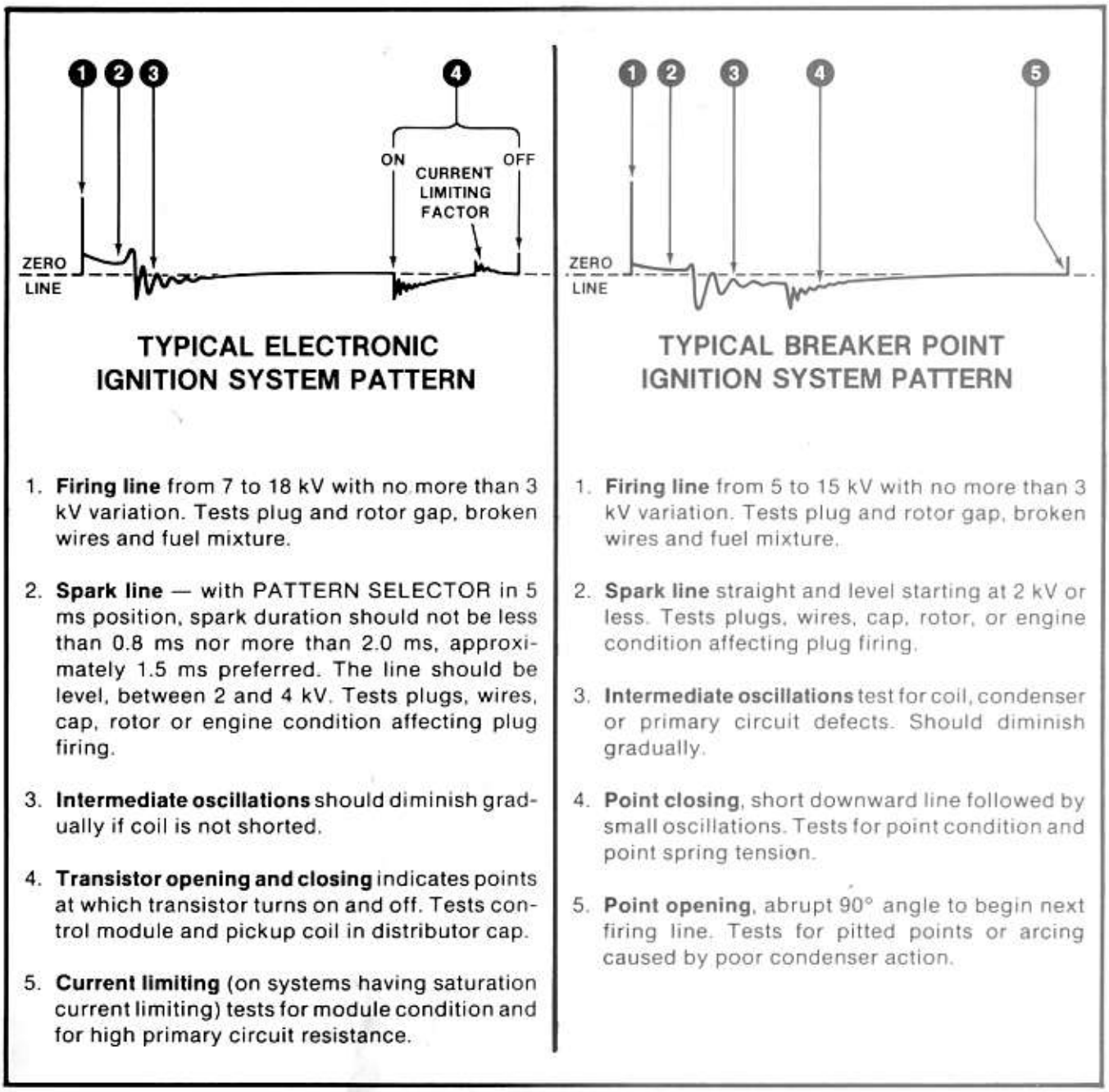
Figure 40. The fourth line of the Vehicle Test page is used exclusively for pinpoint tests. Over range resistance readings are marked (*).

IGNITION AND CHARGING SYSTEM SCOPE TESTING

To obtain maximum value from scope testing requires experience, the use of accumulated test data and careful observation of the scope, watching for abnormal patterns. To enable the operator to recognize abnormal patterns, Figure 41 illustrates normal patterns for various igition systems as points of comparison.

The presence of abnormal patterns may indicate the need to perform one or more of the tests from the charts in this section. Be sure to use the correct chart (electronic or breaker point) when performing tests.

NOTE: Sun has produced a manual entitled "Understanding Automotive Oscilloscope Patterns", which is a complete description of how to perform scope tests and how to interpret the results. Consult your Sun sales representative for details.



TYPICAL ELECTRONIC IGNITION SYSTEM PATTERN

1. **Firing line** from 7 to 18 kV with no more than 3 kV variation. Tests plug and rotor gap, broken wires and fuel mixture.
2. **Spark line** — with PATTERN SELECTOR in 5 ms position, spark duration should not be less than 0.8 ms nor more than 2.0 ms, approximately 1.5 ms preferred. The line should be level, between 2 and 4 kV. Tests plugs, wires, cap, rotor or engine condition affecting plug firing.
3. **Intermediate oscillations** should diminish gradually if coil is not shorted.
4. **Transistor opening and closing** indicates points at which transistor turns on and off. Tests control module and pickup coil in distributor cap.
5. **Current limiting** (on systems having saturation current limiting) tests for module condition and for high primary circuit resistance.

TYPICAL BREAKER POINT IGNITION SYSTEM PATTERN

1. **Firing line** from 5 to 15 kV with no more than 3 kV variation. Tests plug and rotor gap, broken wires and fuel mixture.
2. **Spark line** straight and level starting at 2 kV or less. Tests plugs, wires, cap, rotor, or engine condition affecting plug firing.
3. **Intermediate oscillations** test for coil, condenser or primary circuit defects. Should diminish gradually.
4. **Point closing**, short downward line followed by small oscillations. Tests for point condition and point spring tension.
5. **Point opening**, abrupt 90° angle to begin next firing line. Tests for pitted points or arcing caused by poor condenser action.

Figure 41. Typical Ignition System Patterns.

OSCILLOSCOPE TESTING — IGNITION TESTING — ELECTRONIC SYSTEMS

TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS — POSSIBLE CAUSES AND REMEDIES
Spark Duration test **NOTE: This test can be performed either during cranking or running. The cranking test is usually done on an engine which will not start.**	To determine if the spark duration is acceptable.	1. Set pattern to 5 ms. 2. Set circuit to SEC. 3. Set scale to 0-25 kV. 4. Crank engine and **quickly** read spark duration.	Spark duration should be between 0.8 and 2.0 ms. About 1.5 ms is preferred.	Duration **too short**: 1. High resistance primary 2. Low coil output Duration **too long**: 1. Fouled spark plug 2. Low compression 3. Spark plug gap too small
Spark plug firing voltage	To determine if plug firing voltage is within normal limits.	1. Start the engine and operate at 1000 to 1500 rpm. 2. Set circuit to SEC. 3. Set scale to 0-25 kV. 4. Set pattern to DISPLAY. 5. Note firing line amplitude and position.	Observe firing lines for all cylinders. Firing lines should be between 7 and 18 kV with no more than a 3 kV variation between cylinders.	If firing voltages are **uneven (some high):** 1. Worn spark plugs 2. Breaks in spark plug wires 3. Worn distributor cap 4. Vacuum leaks If firing voltages are **even, but too high:** 1. Open high tension coil wire 2. Worn spark plugs 3. Rotor gap too wide 4. Retarded ignition timing 5. Fuel mixture too lean 6. Faulty distributor cap If firing voltages are **uneven (some low):** 1. Low compression 2. Fouled spark plug 3. Incorrect plug gap 4. Shorted spark plug lead 5. Spark plug insulator cracked

OSCILLOSCOPE TESTING — IGNITION TESTING — ELECTRONIC SYSTEMS (Cont.)

TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS POSSIBLE CAUSES AND REMEDIES
Secondary insulation	Locate secondary circuit insulation breakdowns.	1. Operate engine at 1000 to 1500 rpm. 2. Set circuit to SEC. 3. Set pattern to DISPLAY. 4. Set scale to LOW, 0-25 kV. 5. Connect one end of a jumper lead to ground and the other end to the large portion of the resistance test contactor (Sun P/N 4344-0000). 6. Run the test contactor all over the following components, while observing firing lines on scope. a. Coil tower b. Coil high tension wire and boots c. Distributor cap and terminals d. Spark plug wires and boots	If an insulation breakdown occurs, firing lines will decrease in height.	Replace items having faulty insulation

OSCILLOSCOPE TESTING — IGNITION TESTING — ELECTRONIC SYSTEMS (Cont.)

TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS — POSSIBLE CAUSES AND REMEDIES
Secondary ignition circuit resistance	Determine acceptability of secondary circuit resistance by inspection of spark line slope.	Same as for Secondary Insulation test above.	A good spark line should be between 2 and 4 kV and should be relatively level.	1. Burned rotor tip 2. High resistance plug lead 3. Distributor cap segments burned 4. Faulty spark plug 5. Corroded distributor cap towers
Coil condition **NOTE: This test is not valid for Chrysler EIS systems.**	Determine if coil is in good condition by inspection of oscillations in intermediate section of secondary pattern.	1. Operate the engine at 1000 to 1500 rpm. 2. Set pattern to RASTER. 3. Set circuit to PRI. or SEC. 4. Observe intermediate section of waveform.	Oscillations in the intermediate section should gradually diminish.	1. Shorted coil
Cylinder timing accuracy	Determine if all cylinders are firing in the same relationship to TDC.	1. Operate the engine at 1000 to 1500 rpm. 2. Set pattern to SUPER-IMPOSE. 3. Set circuit to SEC. or PRI. 4. Observe the transistor turn-off area of the waveform.	**4 cyl. engine** — Not to exceed 2% (2 degrees) **6 cyl. engine** — Not to exceed 4% (2 degrees) **8 cyl. engine** — Not to exceed 6% (2 degrees) **NOTE: The above is an approximation since it is impossible to see scope variations of less than one degree with complete accuracy.**	1. Bent distributor shaft 2. Worn distributor bushings 3. Worn distributor drive gear 4. Worn camshaft gear 5. Worn timing chain

OSCILLOSCOPE TESTING — BREAKER POINT SYSTEM

TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS— POSSIBLE CAUSES AND REMEDIES
Maximum coil output voltage (running)	Verify overall condition of ignition system by raising voltage to maximum.	1. Operate engine at 1000 to 1500 rpm. 2. Set circuit to SEC. 3. Set scale to 50 kV. 4. Set pattern to DISPLAY. 5. Use insulated pliers to disconnect one spark plug wire. Hold it away from engine ground. 6. Record maximum rise of firing line on 50 kV scale. 7. Reconnect spark plug lead. **NOTE: Observe manufacturer's recommendations for removing spark plug wires with engine running.**	The coil should produce a minimum voltage of 20 kV.	1. Faulty coil 2. Dwell out of limits 3. Excessive primary circuit resistance 4. Faulty secondary insulation 5. Low primary voltage
Secondary circuit insulation	Locate secondary ignition system insulation breakdowns.	1. Perform steps 1 thru 6 above. 2. Record maximum down-spike of waveform on 50 kV scale. 3. Reconnect spark plug lead.	The downard extension of the firing line should be ½ of the upward extension of the firing line. Absence of a spike or intermittant spikes indicate insulation breakdowns.	If fault occurs in **some** cylinders: 1. Faulty distributor cap 2. Faulty spark plug wires If fault occurs in **all** cylinders: 1. Cracked or carbon tracked coil tower 2. Faulty rotor 3. Faulty coil wires 4. Faulty distributor cap
Secondary circuit resistance	Determine if secondary resistance is abnormally high.	1. Operate the engine at 1000 to 1500 rpm. 2. Set circuit to SEC. 3. Set scale to 25 kV. 4. Set pattern to RASTER. 5. Note the appearance of each waveform spark line.	The spark line should be level and measure 2 to 4 kV. A sloping spark line which begins at a voltage greater than 4 kV and has a shorter than normal duration is abnormal.	1. Rotor tip burned 2. High resistance spark plug wire 3. Distributor cap terminals burned 4. Faulty spark plug

OSCILLOSCOPE TESTING — BREAKER POINT SYSTEM

TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS — POSSIBLE CAUSES AND REMEDIES
Coil and condenser	Determine condition of coil and condenser.	1. Operate the engine at 1000 to 1500 rpm. 2. Set circuit to PRI. or SEC. 3. Set pattern to 500V or 50kV. 4. Set pattern to SUPER-IMPOSE. 5. Observe point open and point close portion of dwell section.	The intermediate section of primary and secondary patterns should be a series of gradually diminishing oscillations.	1. Shorted coil 2. Leaky condenser 3. High resistance lead or poor connection to condenser
Breaker points	Determine condition of breaker points, condenser and distributor cam.	1. Operate the engine at 1000 to 1500 rpm. 2. Set circuit to either SEC. or PRI. 3. Set scale to 25 kV or 25V. 4. Set pattern to SUPER-IMPOSE. 5. Observe intermediate section waveform for gradually dimishing oscillations.	The point close section of the primary waveform should be a short straight downward line. In the secondary, the line should be followed by a few small oscillations. Spikes above the point close kV line or sloping/oscillating point closing lines are abnormal .	1. Breaker point spring tension too weak 2. Excessive distributor vibration 3. Worn or corroded distributor cam 4. Pitted, misaligned, burned or high resistance points 5. Defective condenser

OSCILLOSCOPE TESTING — BREAKER POINT SYSTEM

TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS — POSSIBLE CAUSES AND REMEDIES
Ignition system condition under load (snap acceleration)	Determine individual spark plug performance under load.	1. Operate the engine at idle speed. 2. Set circuit to SEC. 3. Set scale to 50 kV. 4. Set pattern to DISPLAY. 5. Snap accelerate engine to approx. 2000 rpm. Then release the throttle. 6. Note and record the minimum and maximum rise of the firing lines on the 50 kV scale.	All plug firing lines should increase moderately and uniformly. No individual spark line should be extremely high or low in relation to the average.	If firing voltage **too high**: 1. Spark plug gap too wide 2. Worn spark plug electrodes 3. Open spark plug wire 4. Improper fuel mixture 5. Open spark plug resistor 6. Vacuum system leaks If firing voltage **too low**: 1. Shorted spark plug wire 2. Broken spark plug insulator 3. Fouled spark plug 4. Low compression
Cylinder pattern comparison test	To enlarge an individual cylinder waveform for comparison with others.	1. Operate the engine at the desired test speed. 2. Set the circuit to PRI. or SEC. 3. Set scale to 500V or 50 kV. 4. Set pattern to DISPLAY. 5. Select the cylinder to be compared and depress the corresponding keypad number.	This test is primarily to determine whether or not individual waveforms deviate from the norm.	If one or more waveforms is substantially different from the rest, select and perform the scope test in this series of tests which will pinpoint the problem.

OSCILLOSCOPE TESTING — BREAKER POINT SYSTEM (Cont.)

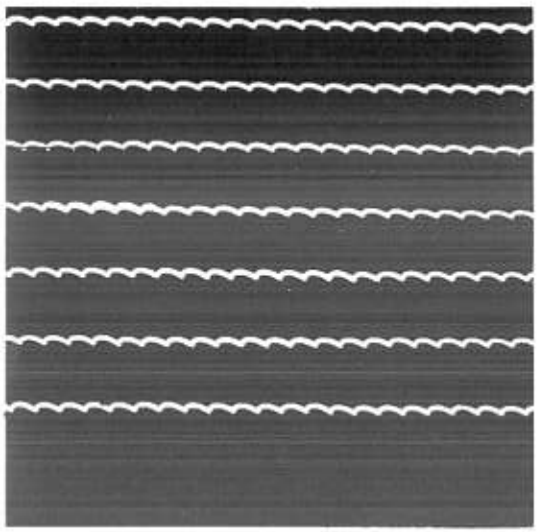
TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS— POSSIBLE CAUSES AND REMEDIES
		8. Compare the enlarged waveform to the others being displayed. 9. Press CANCEL to return to initial state. 10. Repeat above procedure to compare other cylinder waveforms. 11. Select two or more key-pad numbers. These waveforms will be super-imposed at the top of the scope.		
Cylinder timing accuracy	Determine if all cylinders are firing in the same relationship to TDC.	1. Operate the engine at 1000 to 1500 rpm. 2. Set circuit to PRI. or SEC. 3. Set scale to 25V or 25 kV. 4. Set pattern to SUPER-IMPOSE. 5. Record any misalignment (in degrees) of waveform point open patterns.	**4 cyl. engine** — Timing variation should not exceed 2% (2 degrees). **6 cyl. engine** — Timing variation should not exceed 4% (2 degrees). **8 cyl. engine** — Timing variation should not exceed 6% (2 degrees).	1. Worn distributor cam lobes 2. Worn distributor shaft 3. Worn distributor bushings 4. Worn distributor drive gear 5. Worn camshaft gear 6. Worn timing chain

OSCILLOSCOPE TESTING — BREAKER POINT SYSTEM

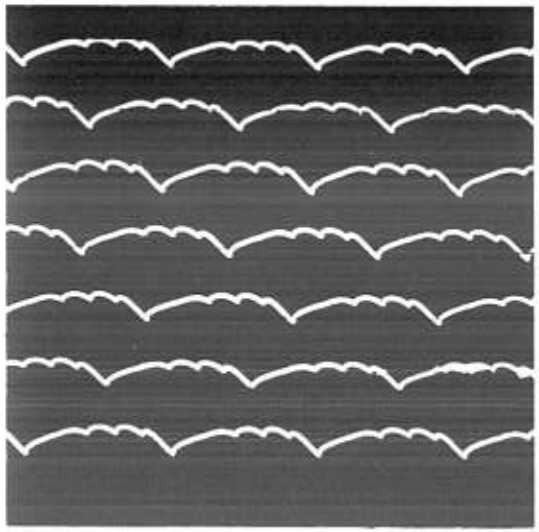
TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS—POSSIBLE CAUSES AND REMEDIES
Coil output while cranking	Verify efficient functioning of primary circuit and coil (usually performed when vehicle won't start or is hard to start).	1. Disconnect the coil secondary lead from the center terminal of the distributor cap. Do not use the ENGINE KILL button. 2. Set circuit to SEC. 3. Set scale to 50 kV. 4. Set pattern to DISPLAY. 5. Crank engine with ignition key ON. 6. Record maximum rise of waveform on 50 kV scale. 7. Stop cranking and reconnect coil lead.	Should produce secondary circuit spikes of at least 20 kV.	1. Battery voltage low. 2. Excessive starter current draw 3. Faulty ignition switch 4. Failure of ballast resistor bypass circuit 5. Incorrect dwell 6. Excessive distributor resistance 7. Faulty coil or condenser 8. Faulty coil wire 9. Faulty primary connection
		NOTE: Observe manufacturer's recommendations concerning open circuit testing.		
Coil polarity	Determine if coil is delivering secondary voltage of correct polarity.	1. Start engine. Operate at 1000 to 1500 rpm. 2. Set circuit to SEC. 3. Set scale to 25 kV. 4. Set pattern to DISPLAY. 5. Note firing line amplitude and position.	Firing line should point up. If it points down, polarity is reversed.	1. Reverse primary connections at coil
Spark plug firing voltage	Determine if firing voltages are within normal limits.	Same as above	Firing lines for all cylinders should be uniform within 3 kV and should be between 5 and 15 kV. If some spikes are higher see causes. When dyno testing under load, firing voltages may increase 2 to 4 kV over no load. Record	1. Worn spark plugs 2. Faulty spark plug leads 3. Worn distributor cap 4. Vacuum leaks

OSCILLOSCOPE TESTING — ALTERNATOR TEST — ALL SYSTEMS

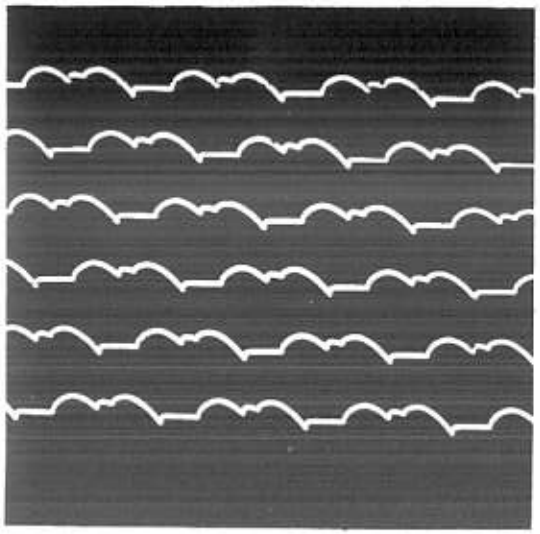
TEST	PURPOSE	TEST CONDITIONS	NORMAL TEST RESULTS	ABNORMAL TEST RESULTS — POSSIBLE CAUSES AND REMEDIES
ALTERNATOR RIPPLE PATTERN	Detect defective alternator	1. Set pattern to RASTER. 2. Set circuit to SPEC. 3. Place the GREEN pickup clamp around the alternator output (+) lead or the positive battery cable. 4. Start engine and operate at approx. 1000 rpm. 5. Turn headlights on and on high beam. 6. Observe waveform and compare to test result column.	A normal alternator output pattern is a series of wave-shaped ripples of the same height and spacing. Under no load conditions, the waveform will have uniform spikes and peaks. Abnormal waveforms will be uneven and jagged.	Faulty alternators must be removed from the vehicle for repair.



Normal Alternator



Open Diode



Shorted Diode

ON-BOARD COMPUTER TESTING

General

The Sun Data Link, Model DL-100, shown in Figure 41a, interfaces with Ford, Chrysler and General Motors electronic engine control systems. An optional accessory, the Data Link is mounted beneath the MEA's VDU and contains a 3.5 inch floppy disk drive.

Through separate disk programs, the Data Link can sample the system's data stream, provide test routines and display trouble codes. Test capabilities depend on the make and model of the vehicle tested. The applicable disk program guides contain specific information about the operation of each disk.

The Data Link is connected to the vehicle diagnostic connector by a Ford, GM or Chrysler diagnostic harness and operated by the remote control keypad.

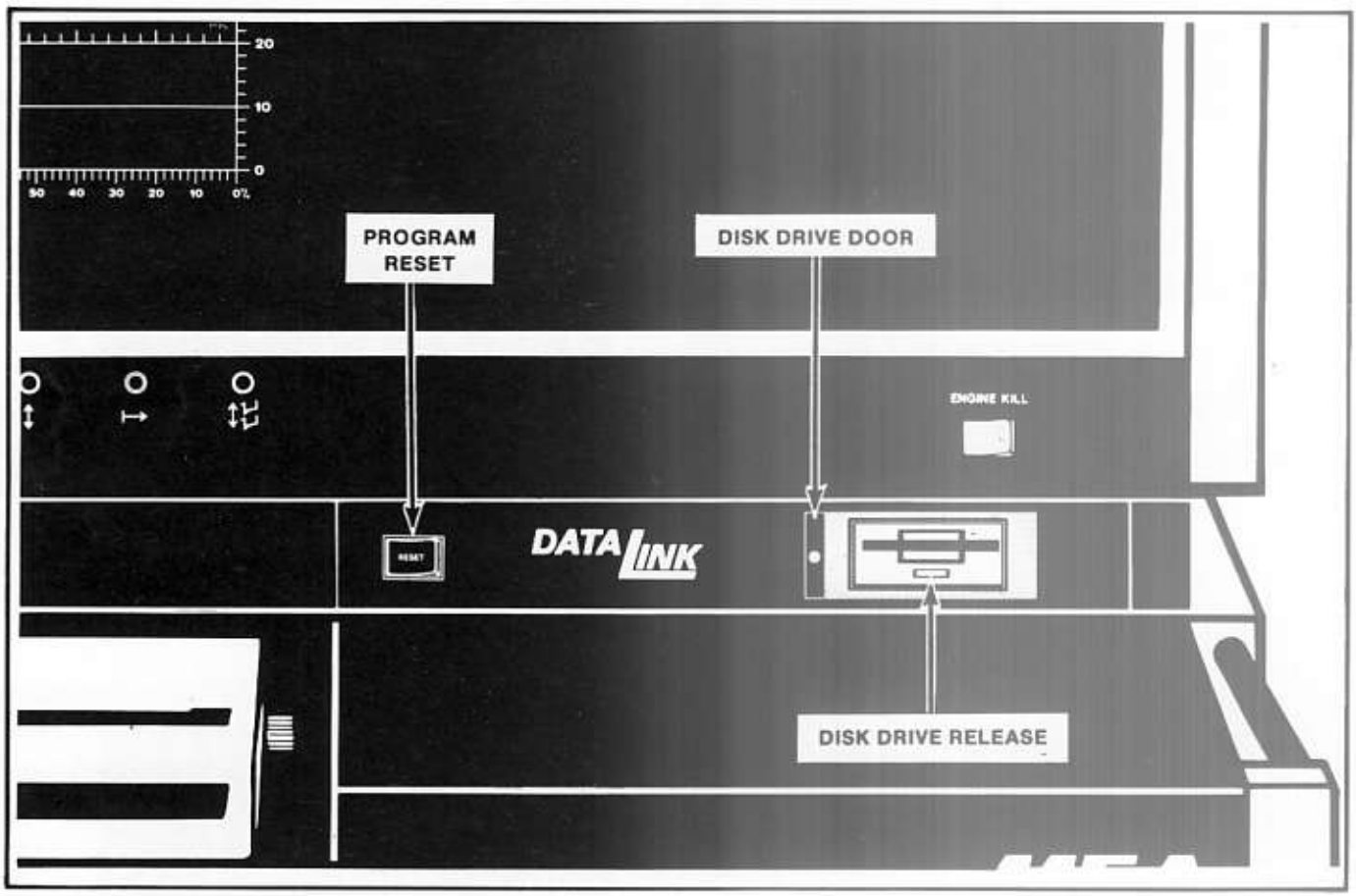


Figure 41a. Data Link

Controls

The analyzer remote control keypad contains three keys (YES, NO and BACKUP) used exclusively for Data Link control; and two keys (CURSOR/ENTER and ENGINE/SET-UP) which combine DATA LINK and engine test control functions. Refer to "Controls" for illustrations and descriptions of these keys.

Backup Function

The Data Link backup function permits the operator to return to a previous Data Link page to review information or to make different entries or selections. The operator can back up within a test sequence. Once the program moves forward into another sequence, in most cases, the program will not backup past this point.

Program Reset Function

The RESET switch (Figure 41a) on the front panel of the Data Link is used to re-start the disk. It may be pressed when changing disks, testing another vehicle, or during testing to start the program over.

Test Preparation And Procedure

Before testing an engine with the Data Link, refer to the manufacturer's recommended procedure for determining if the vehicle problem is caused by failures outside of the electronic engine control system.

Lead Connection

Connect the appropriate diagnostic harness from the connector labeled VEHICLE COMPUTER on the rear of the Data Link to the diagnostic connector on the vehicle to be tested. Ford and Chrysler each use a single standard diagnostic harness for all applications. GM uses either a 5-pin or a 12-pin connector, depending on the year.

1. FORD: Connect the Ford diagnostic harness (PN6004-0443) from the Data Link to the diagnostic connector (Figure 41b) located in the engine compartment.

2. CHRYSLER: Connect the Chrysler diagnostic harness (PN6004-0442) and Chrysler adapter cable (PN6004-0525) from the Data Link to the diagnostic connector (Figure 41c) located in the engine compartment.

3. GENERAL Motors: Connect the appropriate diagnostic harness as follows, depending on the year of the car. For 1981 GM vehicles, connect the 5-pin diagnostic harness (PN6004-0417) to the diagnostic connector (Figure 41d) located under the dash. For all other GM vehicles, connect the 12-pin diagnostic harness (PN6004-0522) to the diagnostic connector (Figure 41e) located under the dash.

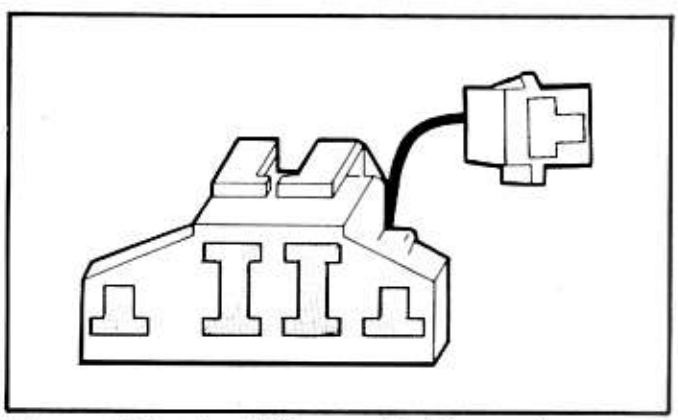


Figure 41b. Ford Diagnostic Connector

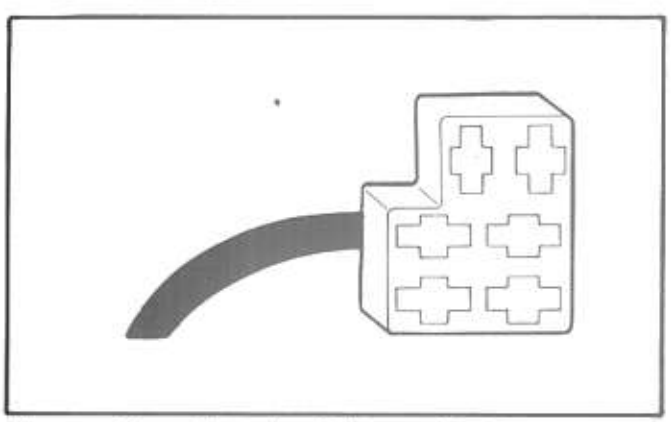


Figure 41c. Chrysler Diagnostic Connector

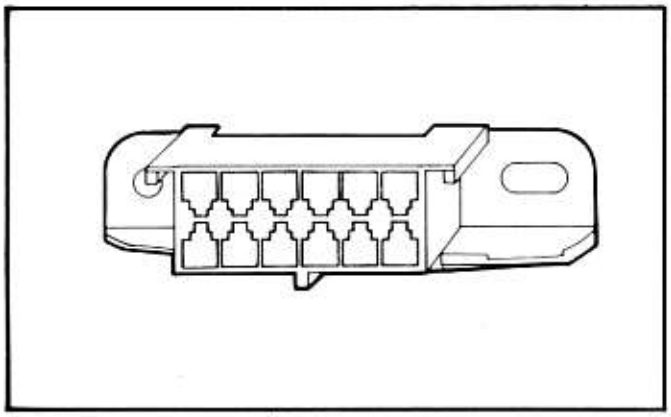


Figure 41d. GM X-Pin Diagnostic Connector

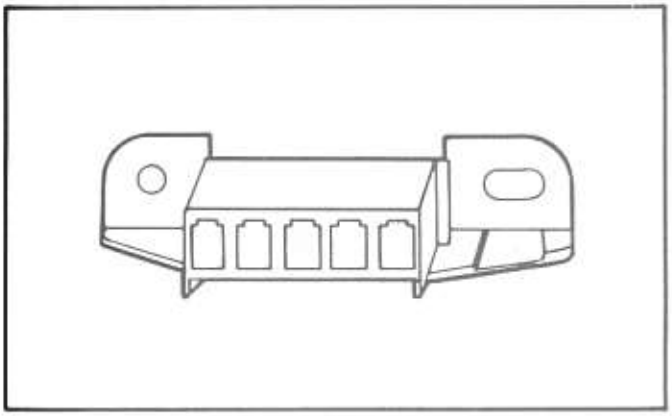


Figure 41e. GM X-Pin Diagnostic Connector

Test Procedure

1. Proceed through the analyzer system check and calibration pages to the PROGRAM MENU page and select the Data Link function. The DATA LINK TITLE page will be displayed.

2. Slide the disk drive door and insert the metal shutter end of the correct disk for the vehicle make being tested into the slot (label side up). Push in until the disk drive (Figure 41a) latches.

3. Follow other instructions displayed on the VDU. For more specific information about the operation of each disk, refer to the Program Guide for the disk being used.

4. During disk operation, it is possible to leave the Data Link program at any point and select other analyzer functions.

   A. Press the ENGINE/SET-UP key to advance directly to the VEHICLE TEST page.

   B. Press the MENU key to return to the PROGRAM MENU page and select other functions (ie. power balance, vehicle set-up, etc.).

   C. Press the CONT key to return from analyzer pages to the Data Link page which was previously left.

5. Analyzer scope, print and freeze functions are operative during the Data Link program. Scope settings will appear in reverse video at the top of Data Link pages. It will not be possible to select individual cylinder scope displays while in the Data Link mode. Individual cylinder scope displays are available from the Vehicle Test page.

After Testing

1. Disconnect the Data Link diagnostic harness.

2. Press the disk release (Figure 41a) and remove the disk. Return it to the disk sleeve in the MEA-1500 three-ring binder.

3. Press the MENU key to return to the PROGRAM MENU page, or turn power OFF.

NOTE: It is recommended that the disk be removed from the Data Link before power is turned off.

Routine Maintenance

Test Lead Maintenance

The diagnostic harnesses will retain their new appearance if they are cleaned periodically with waterless, non-abrasive hand cleaner and wiped dry.

Care And Maintenance Of Disks

Disks should be kept clean and dry, and should be stored in the disk sleeve when not in use.

CAUTION: Magnetic materials, such as magnetized screw drivers, electric motors, coils, HEI distributors, etc., should be kept away from the disks, which can be ruined with a magnet.

Maintaining Tester Finish

The Data Link has a stain-resistant baked enamel finish, which should be polished with automobile wax and periodically wiped with a damp cloth.

PRINTER OPERATION AND MAINTENANCE

General Description

The optional printer is installed to provide service shops with actual proof of tests performed on vehicles serviced. Installation and set-up of the printer is provided by service personnel.

Perforated print paper, divided into 9 1/2" x 11" sections (P/N 0528-0994), is bottom-fed into the printer from a paper storage compartment. Replacement ribbon cartridges (P/N 0528-0995) install easily.

Printer Controls

NOTE: All controls on the front of the printer (Figure 42) should be disregarded since all printer functions are performed automatically through the remote control keypad upon installation and power-up.

Pressing the printer buttons may affect the printer operation.

The three indicator lights on the printer front panel (Figure 42) do provide the operator with useful data.

SEL light—The SEL light indicates communication with the engine analyzer. The light must be on for the printer to operate.

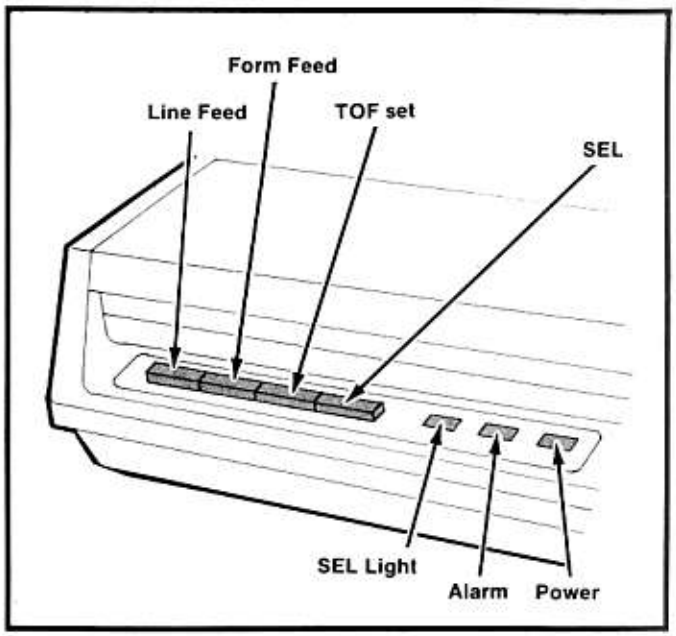


Figure 42. Front Panel Buttons and Indicators.

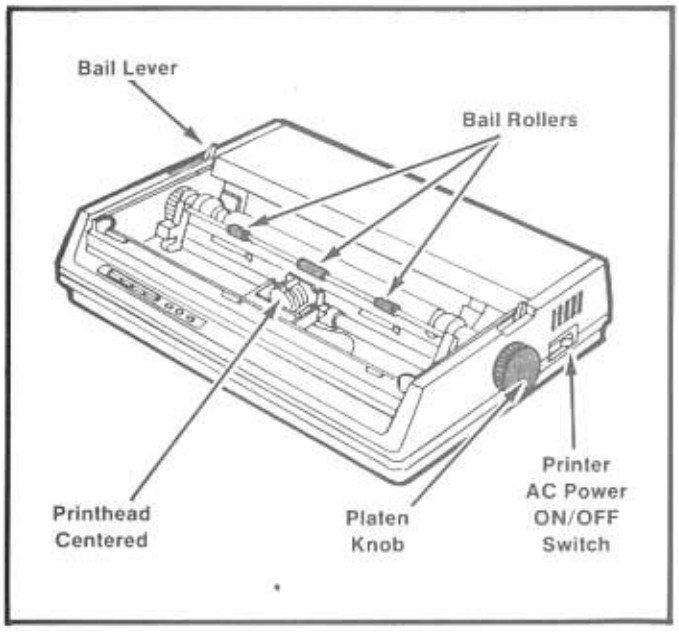


Figure 43. Location of Controls.

ALARM — The ALARM lights when paper is out. Printing stops until paper supply is replenished. The VDU will also give an indication of empty paper supply.

The ALARM also lights when the printhead becomes jammed or stopped during the printing process.

POWER — The POWER light indicates that the AC switch (Figure 43) is on and the printer is powered up.

The printer also has integral factory-set switches that must not be altered or re-set in any way. The rear cover of the printer should **not** be removed.

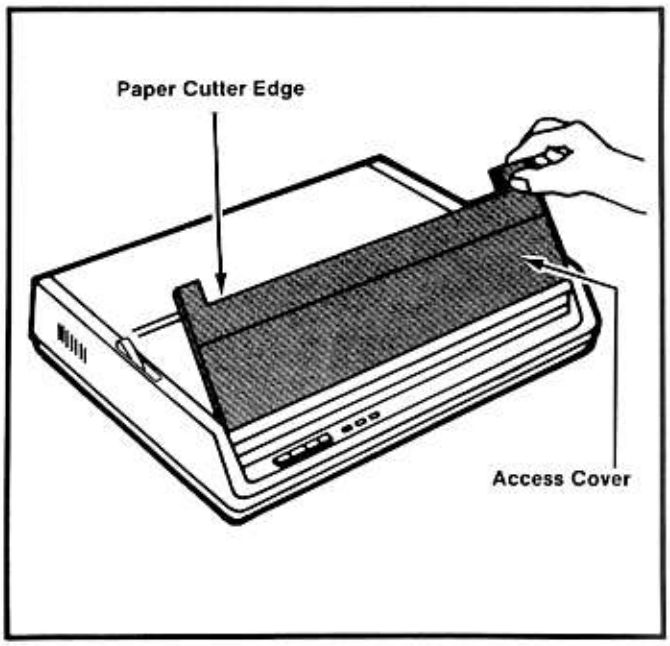


Figure 44. Access Cover Removal.

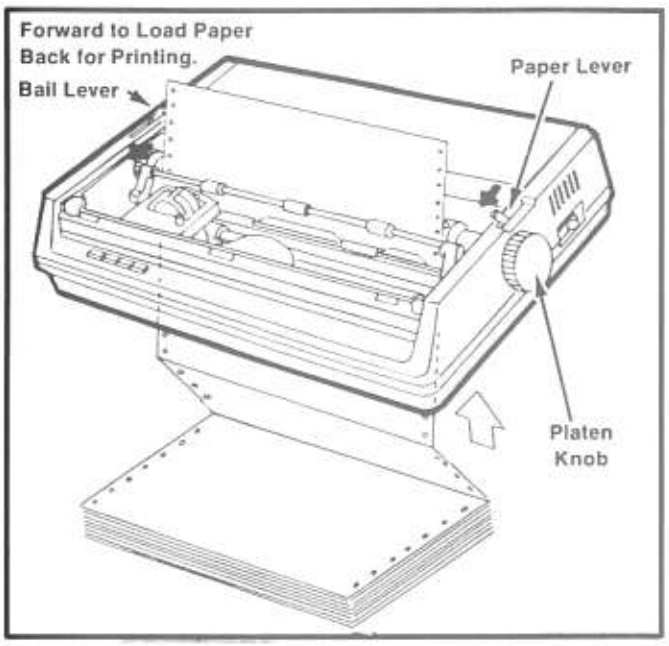


Figure 45. Bottom Paper Feed Loading.

Paper Loading

1. Turn the printer AC power switch (Figure 43) to PRINTER OFF. (POWER indicator light OFF.)

2. Remove the printer access cover (Figure 44) by lifting it off.

3. Place the stack of print paper in the compartment below the printer.

   NOTE: Only one-part paper perforated into 9 1/2" x 11" sections with pin feed holes (P/N 0528-0994) should be used.

4. Lift the bail. (Bail lever forward.) The paper lever should be open (forward). Refer to Figure 45.

5. Take the first sheet of paper and feed it through the bottom of the printer and into the paper guides, as per Figure 45.

6. Align and mount the holes of the paper with the corresponding pins (Figure 46).

   NOTE: Adjustable pin feeds should always be set to accommodate 9 1/2" width print paper (P/N 0528-0994). If for some reason pin feed width is not set at 9 1/2", re-set by pushing the pin feed adjustment levers (located just to the outside of each set of pins) forward and sliding the mechanism(s) to the correct (9 1/2") width. Push adjustment levers back into place to lock mechanism in new position. Refer to Figure 46.

7. Lower the bail and replace the access cover.

8. Turn printer power switch back ON. (POWER indicator light and SEL light ON.)

9. Press PRINT on the remote keypad twice quickly. Paper will automatically advance.

10. After the paper stops advancing, advance the paper manually with the platen knob until a perforation is lined up with the tear-off edge of the printer access cover.

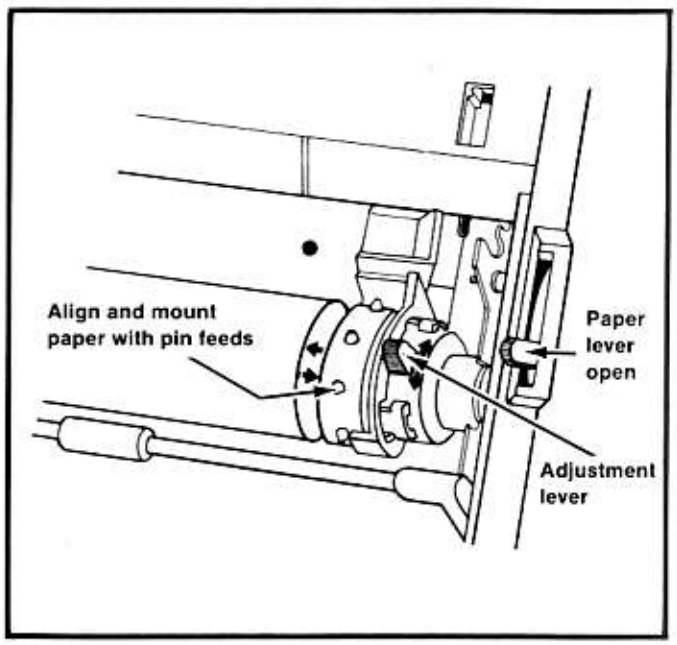


Figure 46. Adjustable Pin Feed.

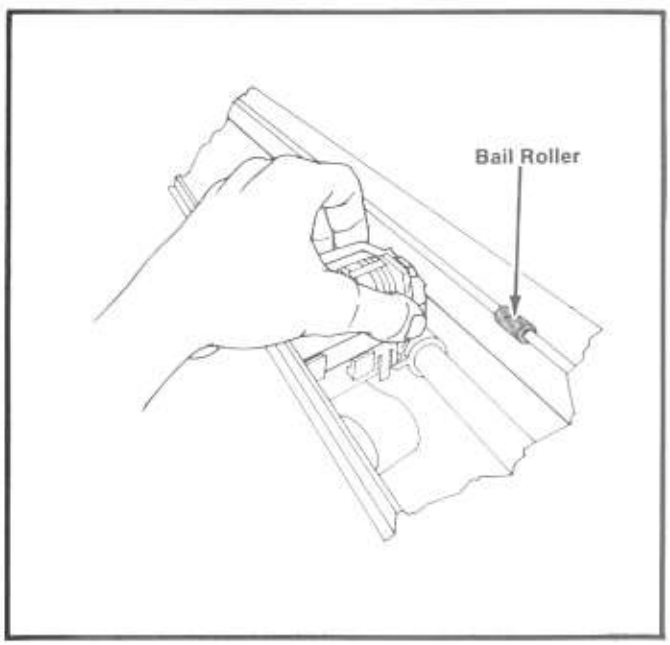


Figure 47. Grasp Cartridge Lift Up.

Printer Maintenance

Ribbon cartridge replacement

1. Turn the printer AC power switch OFF. (POWER indicator light OFF.)

2. Remove the printer access cover.

3. Gently slide the printhead to the middle of the printer (Figure 43).

4. To remove the old ribbon cartridge, grasp it on either side of the printhead and lift up (Figure 47).

5. Install the new black ribbon cartridge (P/N 0528-0995) by inserting the cartridge on to the printhead plate.

   To insert the cartridge on printhead plate, tilt the side of the cartridge opposite the ribbon shield so that portion of the cartridge slides on to the front of the printhead plate. Lower the top of the cartridge containing the side with the ribbon shield over the printhead. See Figure 48. (Do **not** remove the ribbon shield.) A tab on each side of the cartridge will align perfectly with inserts on the printhead plate (Figure 49).

6. Press gently on the cartridge until it snaps into place (Figure 50).

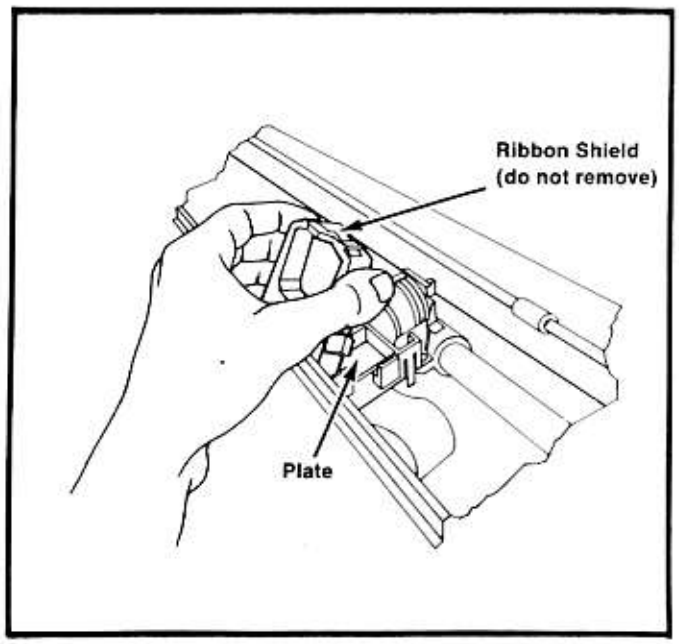


Figure 48. Installing Ribbon Cartridge.

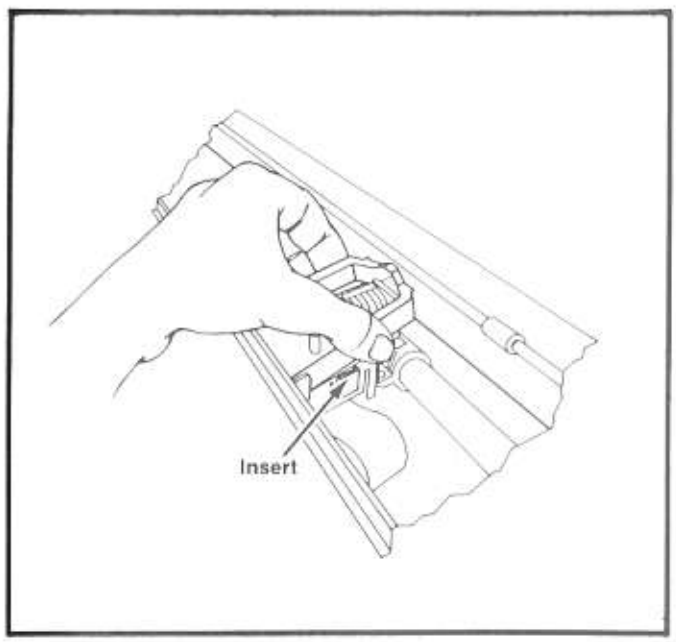


Figure 49. Installing Ribbon Cartridge.

7. Be sure the blue printhead gap lever, located to the left of the ribbon cartridge (Figure 51), is set in the number one (1) position.

Basic troubleshooting

Basic settings and controls should be checked before calling for Sun service:

1. The AC switch on the printer must be turned on, as indicated by the lit POWER light on the front panel.

2. Printer must be in SEL mode, indicated by the SEL light on the front panel.

3. Bail lever should be positioned toward the back of the printer during operation. (Rollers should be in contact with paper.) Paper lever should be positioned toward the front.

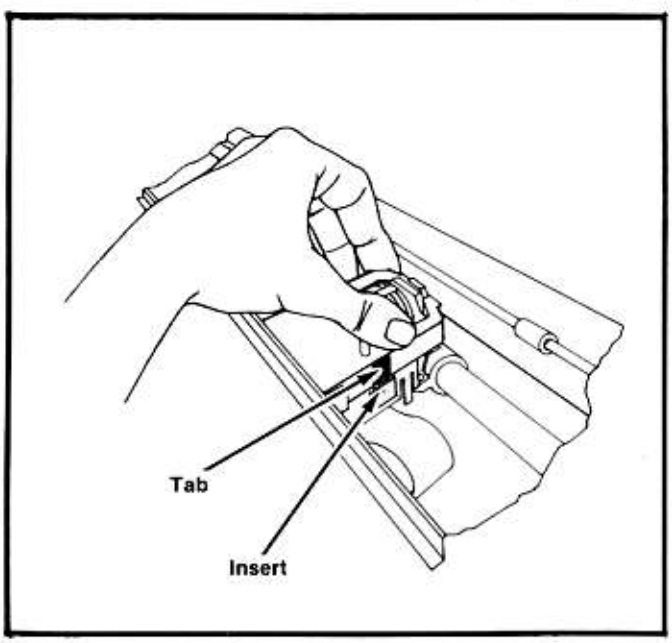


Figure 50. Press Gently on the Cartridge.

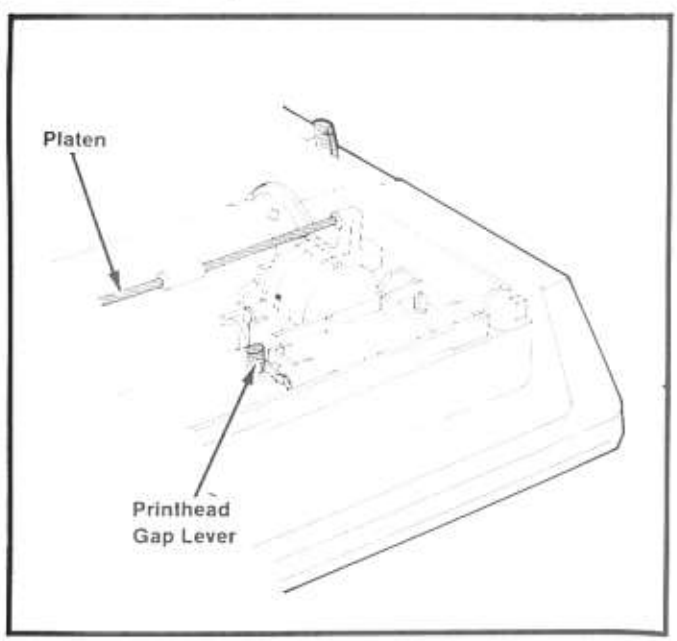


Figure 51. Location of Printhead Gap Lever.

4. Blue printhead gap lever should be in number one (1) position.

5. The ALARM should be OFF. If the ALARM indicator is ON, check to see if paper supply is full and is loaded properly and also check to see if printhead is jammed or stopped.

Routine maintenance

For trouble-free operation, the printer should be cleaned as follows at least once a month (or after 300 hours of operation):

NOTE: Do not apply any lubricants to the printer.

1. Turn off AC power. Remove paper from printer.

2. Remove the printer access cover.

3. Using a clean, dry, soft cloth, dust the area around the carriage shaft, platen, and paper sensor. Remove any loose paper particles or other debris.

4. With the nozzle attachment of a vacuum cleaner, vacuum the carriage shaft and paper feeding areas very carefully to remove any accumulated dust. Do not use a compressed air supply.

5. Re-load paper (see "Paper Loading") and replace the access cover.

Printer Operation

Before operating printer, verify that the paper has been loaded correctly and the proper indicators are lit as described in "Printer Controls". Also check that bail lever and paper lever are set as shown in Figure 45.

Setting Top of Form

1. At printer power-up, always **manually** set top-of-form (TOF). This is done by advancing the paper with the platen knob until a perforation is lined up with the tear-off edge of the printer cover.

   NOTE: Do not attempt to use the TOF SET and FORM FEED buttons on the printer. The MEA automatically controls the printer. Pressing these buttons may adversely affect the printer operation.

Printing

2. To print a VDU page, simply press the PRINT button on the remote keypad. After a momentary pause, information presented on the VDU will be printed and several blank lines will be added to separate the next printed page. The indicated prompts on the VDU will **not** appear on the printouts.

Removing a page

3. After a page has been printed, press the remote PRINT key twice quickly. The paper will automatically advance until the next perforation is aligned with the printer cover.

   NOTE: If the perforation does not align with the edge of the printer cover, manually turn the platen knob until the perforation is in line.

4. Tear the paper off against the edge of the printer cover.

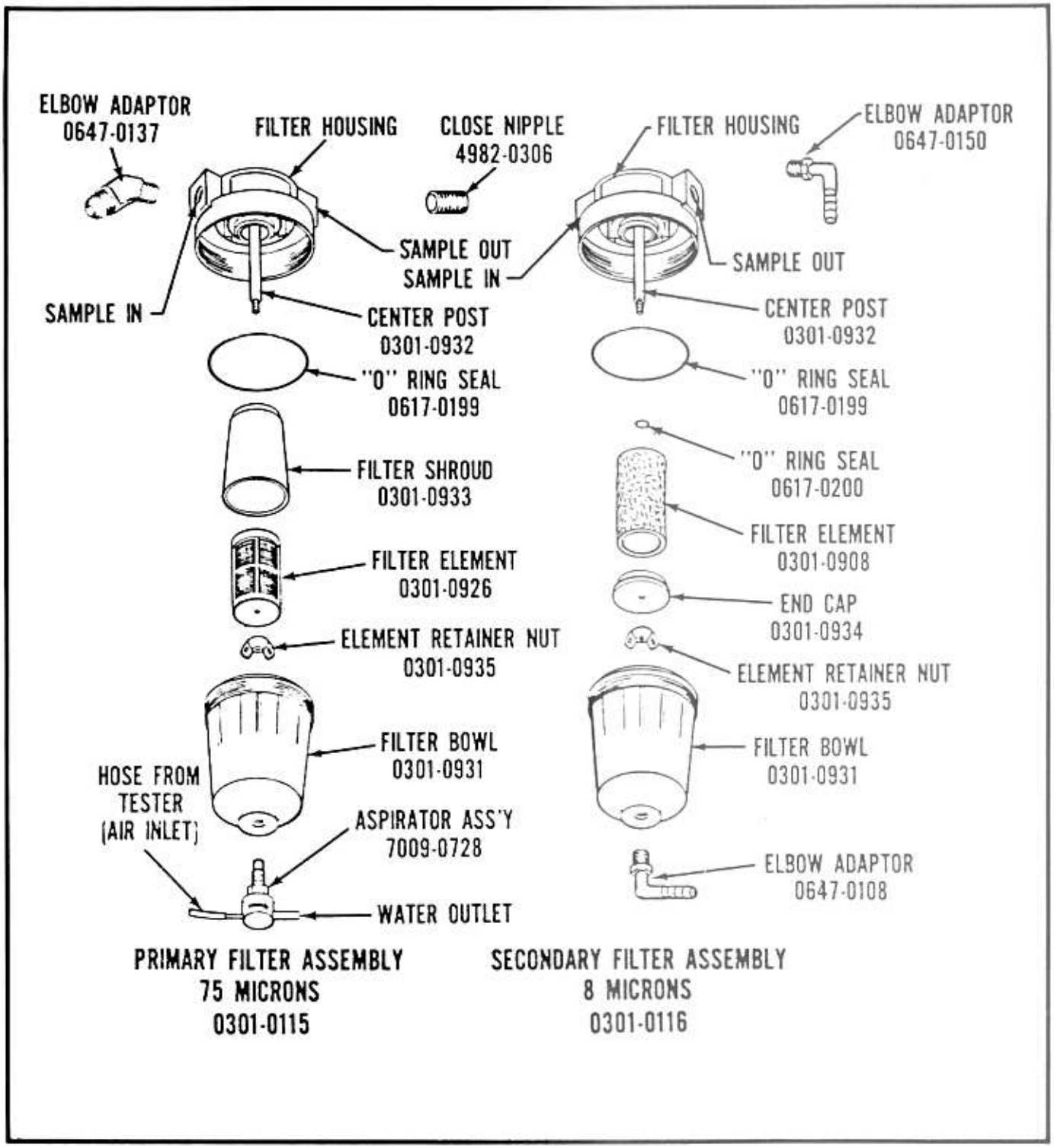


Figure 52. Sample Filter Arrangement.

MAINTENANCE and SERVICE

General

The maintenance and service procedures for the engine analyzer presented in this section are those in which the operator can perform. All other service should be performed by an authorized representative. If an emissions module option is not installed, the filter and sample probe maintenance procedures are not applicable.

Sample Hose Maintenance

Periodically inspect the SAMPLE HOSE for any signs of damage such as leaks, cuts, and kinks. Also, check sample hose connections for tightness. Replace hose if leaks are found or suspected.

Sample Probe Maintenance

Frequently inspect the SAMPLE PROBE for damage. Check for clogged holes in the probe tip. If the holes are found to be clogged, use a piece of stiff wire or other suitable object to dislodge and remove any foreign matter.

Filter Maintenance

When to service

The primary and secondary filters should be replaced or cleaned when the LOW FLOW message appears. Before replacing or cleaning the filters, however, it is recommended that the sample probe be serviced and/or cleaned. Then, if the response time is still slow, clean or replace the filters.

A label explaining filter maintenance and installation appears on the back of all testers.

Primary Filter Service

The primary filter element may be cleaned or replaced. Service the primary filter as follows:

1. Disconnect the water outlet and air inlet hose from the fitting on the filter bowl. See Figure 52.

2. Unscrew the filter bowl from the filter housing by turning the bowl counterclockwise.

   CAUTION: When removing the filter bowl, be careful not to damage the "O" ring.

3. Turn the element retainer nut counterclockwise and remove the filter element.

4. Wash out the filter bowl and element in a mild soap and water solution. Allow the bowl and element to dry before reassembling.

5. Reassemble the primary filter in reverse order of disassembly.

   NOTE: Be sure the "O" ring is properly positioned in the groove of the filter bowl.

6. Reconnect the water outlet and air inlet hoses.

Secondary Filter Service

The secondary filter element must be replaced when it becomes dirty or clogged. Service the secondary filter as follows:

1. Disconnect hose from the elbow adapter. See Figure 52.
2. Unscrew the filter bowl from the filter housing by turning the bowl counterclockwise.

   CAUTION: When removing the filter bowl, be careful not to damage the "O" rings.
3. Turn the element retainer nut counterclockwise and remove the end cap.
4. Remove and discard the old filter element.
5. Wash out the filter bowl in a mild soap and water solution, then allow it to dry.
6. Install a new filter element.
7. Reassemble the secondary filter in reverse order of disassembly.

   NOTE: Be sure the "O" rings are properly positioned during assembly.

Maintaining Tester Finish

The Modular Engine Analyzer has a finish of stain resistant baked enamel and brushed aluminum. It is recommended that the painted and plated surfaces be polished with automobile wax. Once this has been done, a periodic wipedown with a dry cloth will be sufficient.

Lubrication

Every sixty to ninety days, apply a light machine oil to the cabinet casters so they will roll freely.

Test Lead Maintenance

The test leads and power cord will retain their new appearance if they are cleaned periodically with waterless hand cleaner and wiped dry.

Calibration

To select the CALIBRATION MENU (Figure 53), return to the original PROGRAM MENU and select the fourth option.

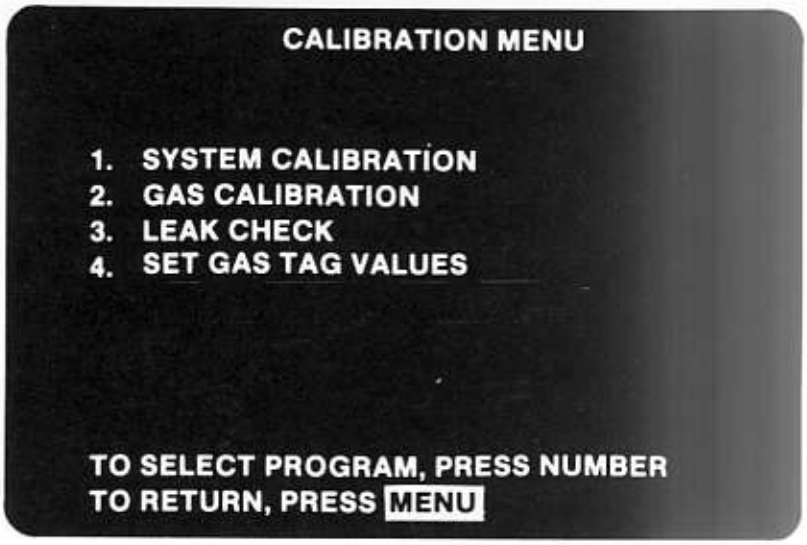


Figure 53. Calibration Menu (Emissions).

NOTE: The CALIBRATION MENU is available only when the emissions option is installed.

The four selections on the CALIBRATION MENU are explained in the following paragraphs. HELP messages are available to the operator throughout the calibration sequence.

To perform selections two through four, a bottle of certified calibration gas (supplied locally) and Kit. No. 120-446-1 (with a pressure regulator and calibration hose) must be attached to the brass fitting of the gas calibrate port on the back of the unit. The toggle switch above the filters should also be set to the OPERATE position. The hexane/propane ratio and the gas values on the certification tag of the gas bottle must be set with values required by the state before gas calibration and leak check can be performed.

Selection #1: System Calibration

This page (Figure 54) is identical to the general test calibration page which appears automatically after the self-test/warm-up page upon system power-up. It allows the analyzer to be re-calibrated without having to turn the unit off and perform self-test/warm-up procedures over again.

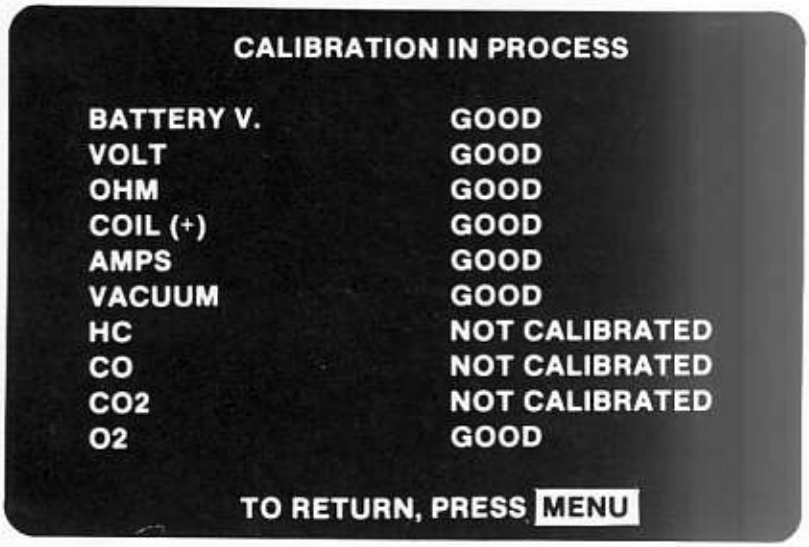


Figure 54. Calibration Page.

NOT CALIBRATED appears on emissions (HC, CO, CO_2, or O_2) if tester is not fully warmed up. If NOT CALIBRATED appears, return to main CALIBRATION MENU and perform calibration when WARM-UP COMPLETE appears on the menu page with the prompt to proceed.

If SERVICE REQUIRED appears on the VDU, remove all connections from engine and repeat calibration.

Additional information for "System Calibration" page is available through HELP messages.

Selection #2: Gas Calibration

This selection is used to verify the accuracy of the analyzer's HC, CO_2, O_2, and CO measurements. Follow the instructions on the VDU to gas-calibrate the analyzer. Consult HELP messages for additional data.

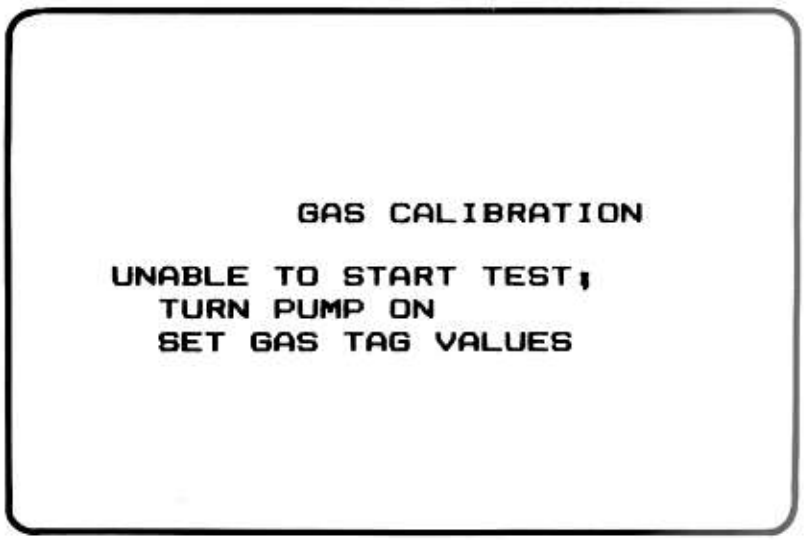


Figure 55. Gas Calibration Message.

USE BAR
97 LOW
CAL GAS

NOTE: Before gas calibration can be performed, the hexane/ propane ratio and the gas values on the certification tag of the gas bottle must be set (Figure 55). Refer to Selection #4 of the main CALIBRATION MENU (described below) to set the values.

Gas calibration must be completed before a leak check can be performed.

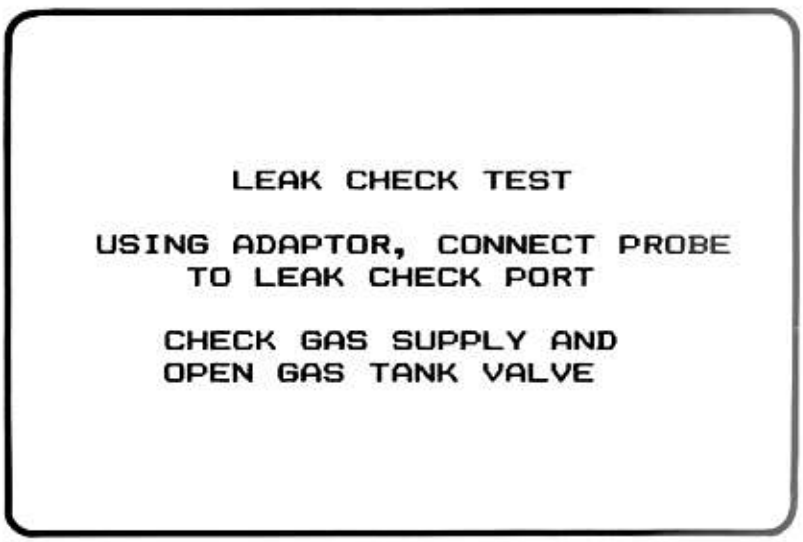


Figure 56. Leak Check Message.

Selection #3: Leak Check

The leak check is performed to verify that exhaust sampling system of the analyzer is air-tight and free of leaks after sampling system component replacement or cleaning. The messages for performing the leak check will be automatically displayed (Figure 56).

If the leak check is o.k., LEAK CHECK PASSED will be displayed. If any other message displays, check hose, probe, connections, filters—or whatever system is indicated on the screen—for leaks prior to repeating test. If the check fails a second time, call for Service.

Selection #4: Set Gas Tag Values

This page allows hexane/propane ratio and gas tag values to be set (Figure 57). These values must be entered **prior** to gas calibration procedure.

Enter values as per instructions on the screen.

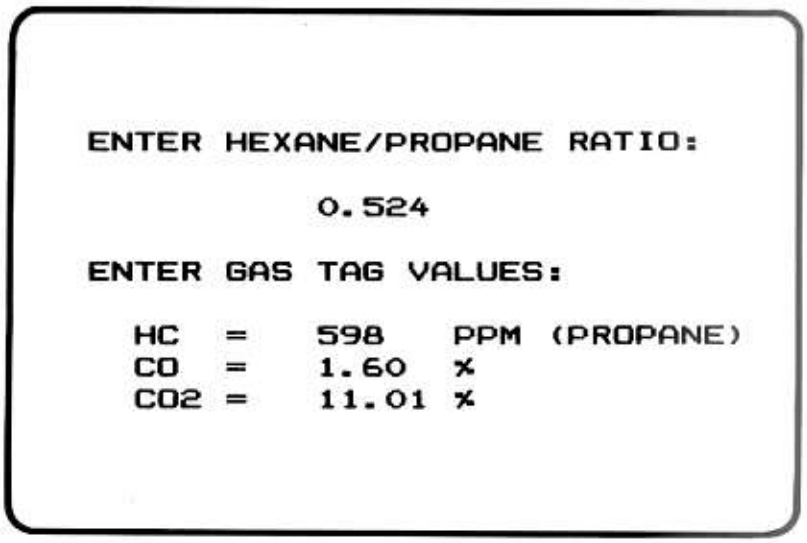


Figure 57. Hexane/Propane Ratios and Gas Tag Values Set.

1. Enter Hexane/Propane ratio.

   The hexane/propane ratio is located on a label on the rear of all testers. Using the numeric keys, enter this ratio. The data entry field to be filled in will be indicated in reverse video.

2. Enter gas tag values from calibration bottle certification tag. Data entry field to be filled in will be indicated in reverse video.

   NOTE: If hexane gas is used, HC value must be transferred to propane equivalent.

   To convert hexane tag value into propane equivalent, divide the hexane tag value by the hexane/propane ratio.

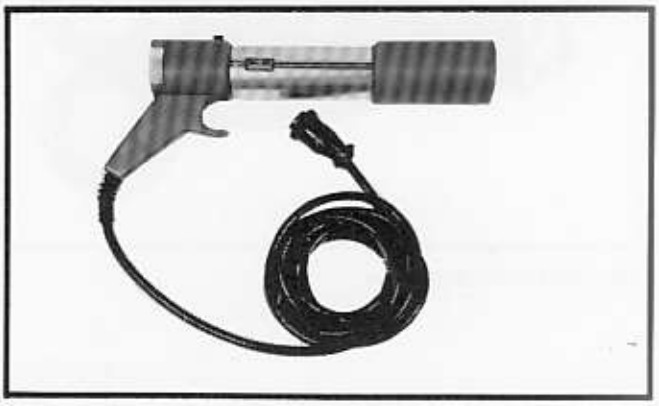
   For example, if the hexane tag value is 300 ppm and the hexane/propane ratio is .52, then 300 divided by .52 equals 576. Enter 576 for HC propane ppm reading.

   If the analyzer will not accept the gas tag values entered, entries will flash. Re-check numbers and re-enter.

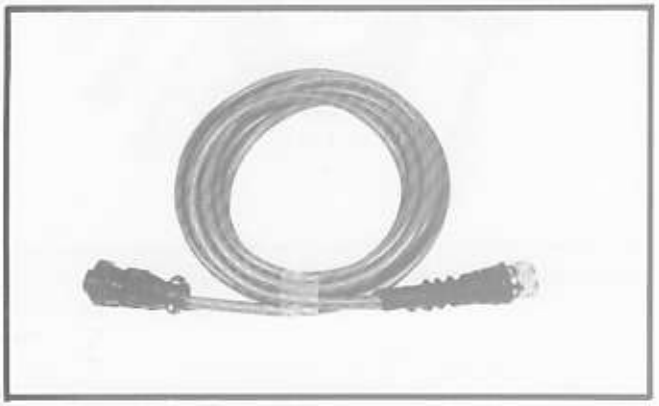
   Consult HELP messages for additional data.

STANDARD AND OPTIONAL ACCESSORIES

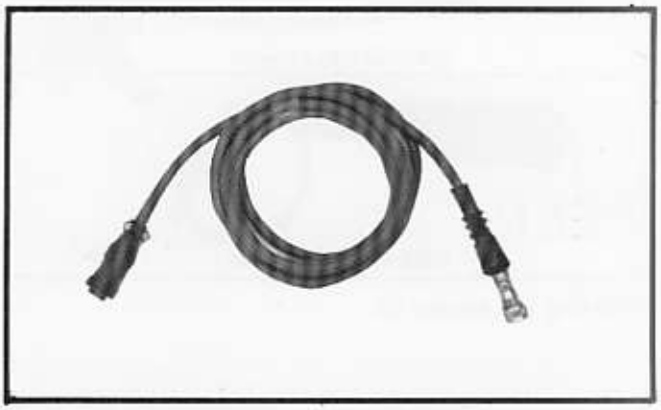
STANDARD



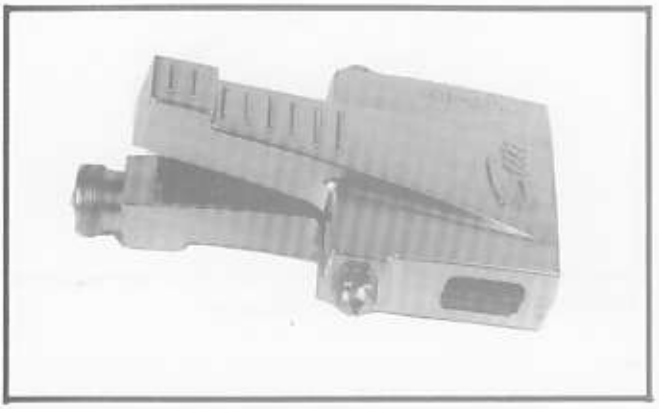
7009-1704-01 Timing Light Assembly



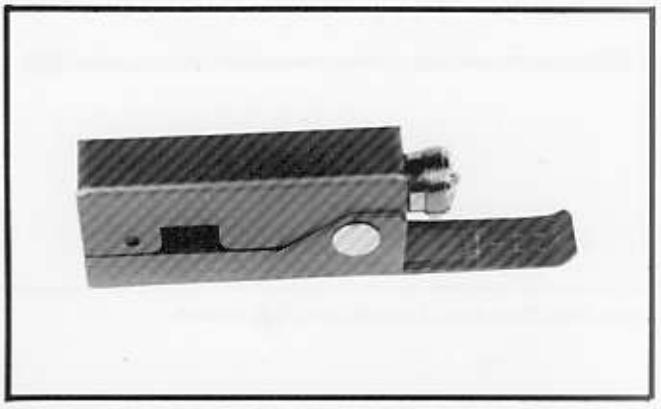
6004-0262-03 Test Lead Trigger Assembly



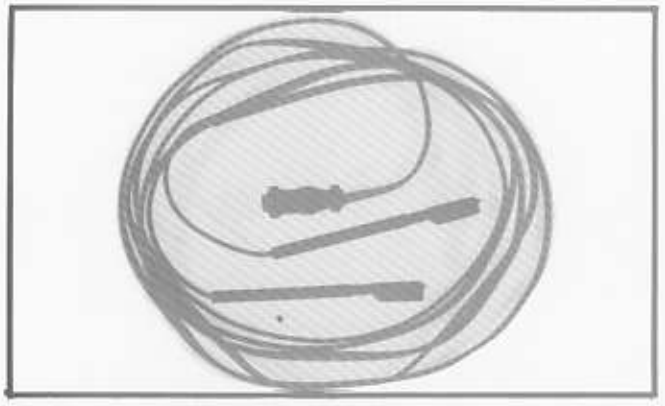
6004-0332-01 Test Lead Pattern Assembly



1747-0101 Chrome Pattern Pick-up Assembly

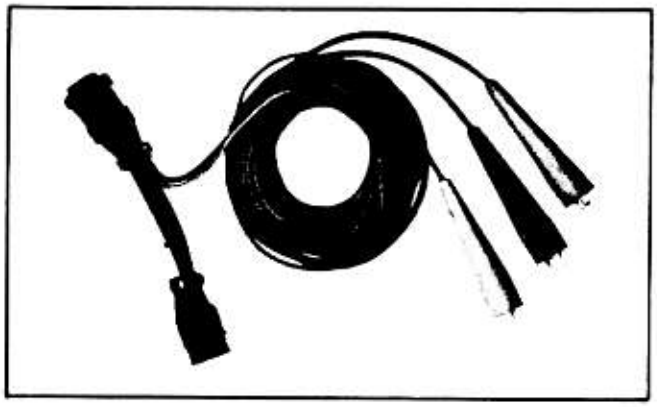


0507-0006 Trigger Pick-up Assembly

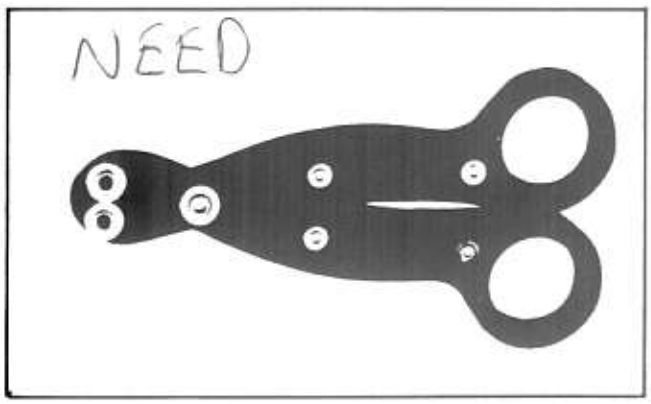


6004-0462 Test Lead Assembly, Volt Ohm

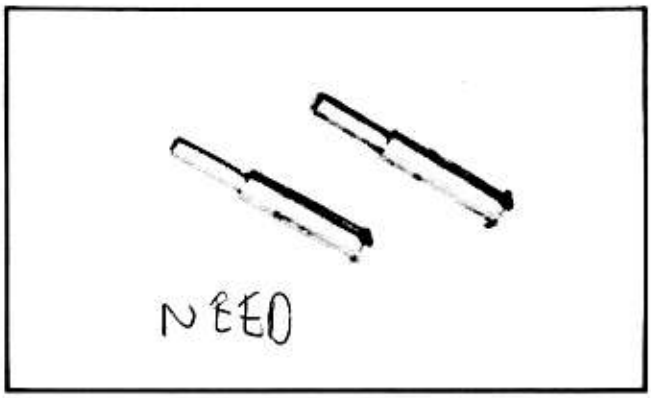
STANDARD (continued)



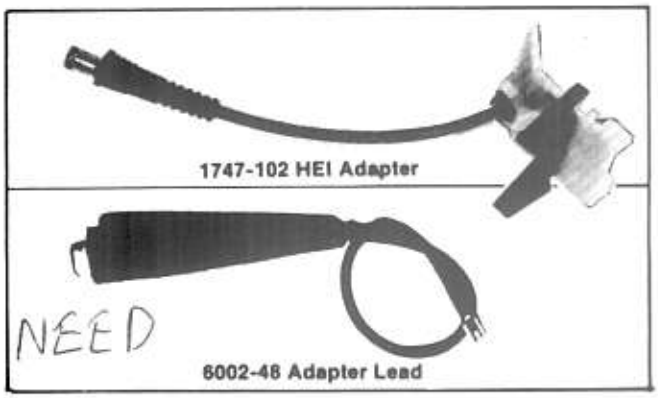
6005-0161-01 Universal Test Lead Assembly



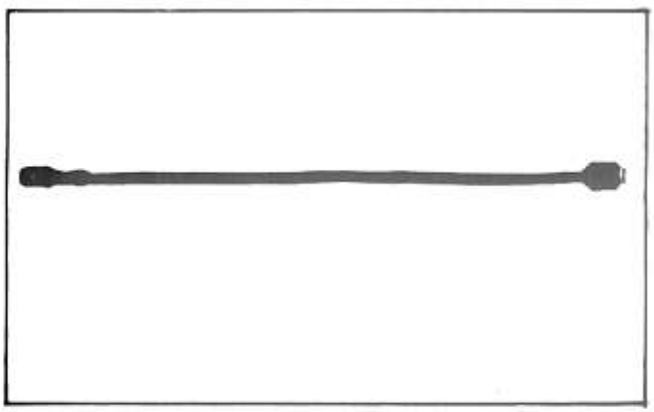
0002-1028 Insulating Pliers



3676-0501 Ignition Coil Terminal Adapters

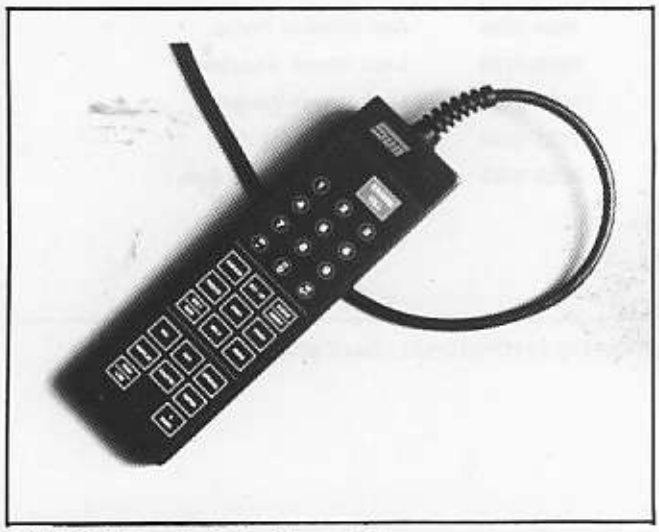


0120-0240 HEI Adapter Kit



6005-0067 Test Lead Assemblies (2) (1 shown)

STANDARD (continued)

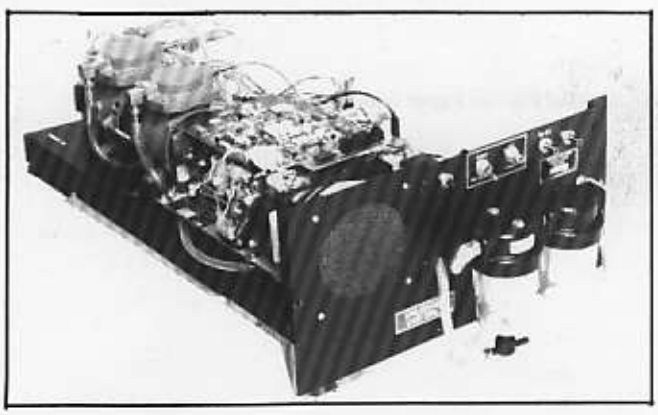


7009-1892 Remote Control Assembly

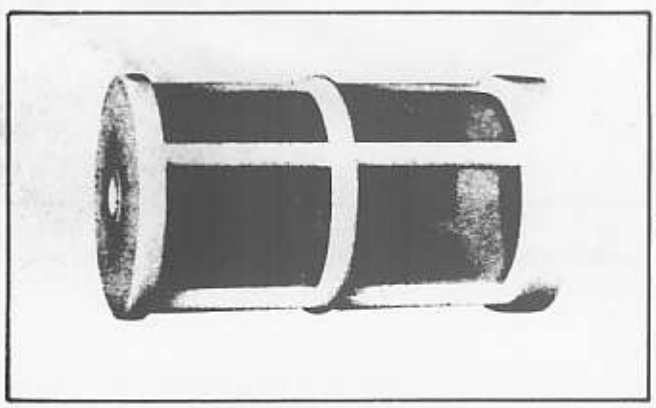
0002-0133-15 Test Lead (not shown)

OPTIONAL

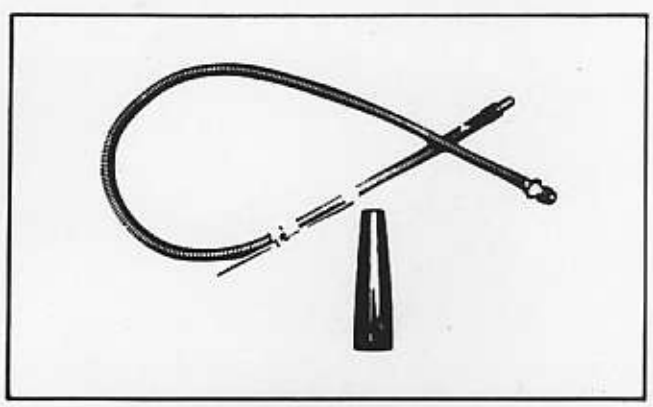
4-Gas Option Includes:



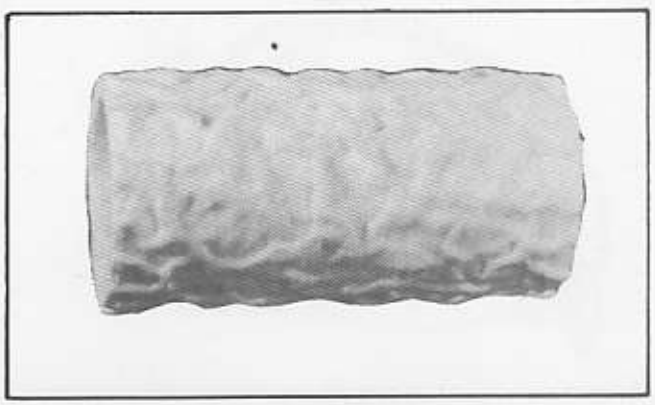
0120-0492 4-Gas Option



301-926 Primary Filter Element, 75 micron

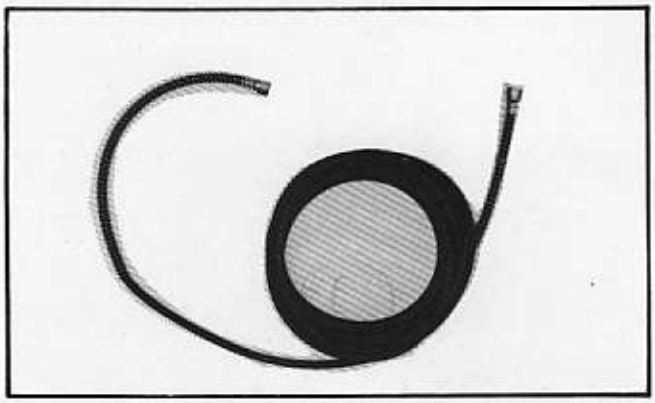


7009-1869 Exhaust Sampling Probe



301-908 Secondary Filter Element, 8 micron

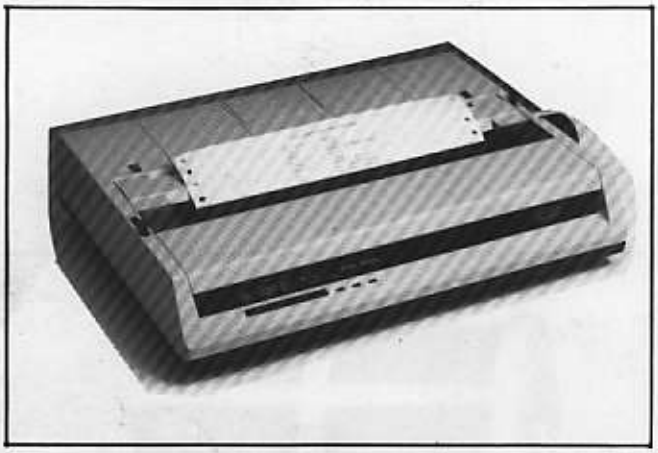
OPTIONAL (continued)



3988-216 Exhaust Sample Hose

7009-1506	Anti Dilution Probe
7009-1730	Leak Check Adapter
7009-1700	Leak Check Adapter
0131-0024	Gas Regulator
7020-1655	Sample Gas Weld Assy.

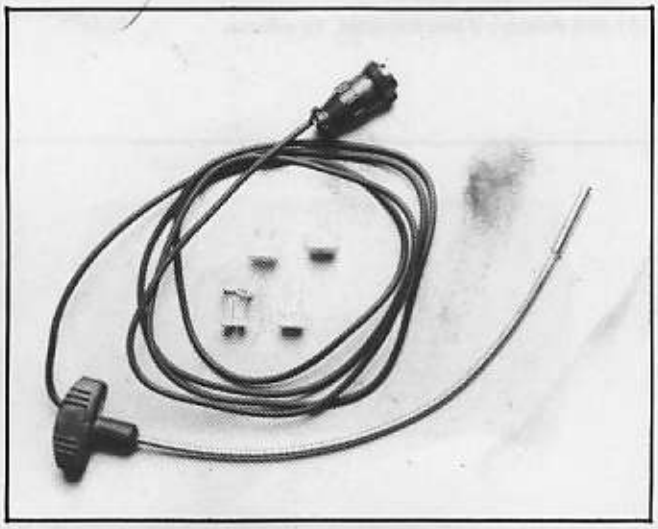
0120-446-01 (OPTIONAL) Gas Calibration Kit (not shown)



AP1000 Printer with 0120-0500 Kit

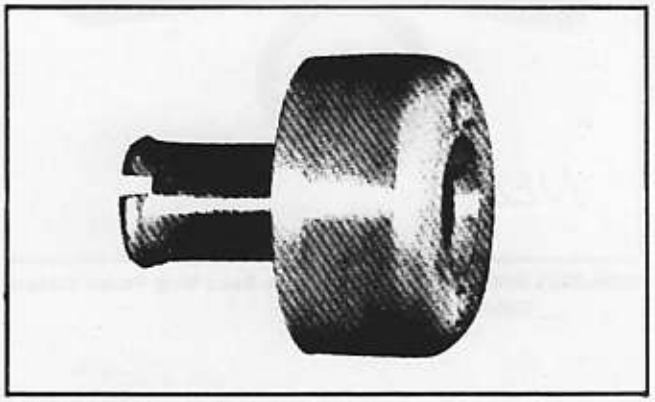
0528-0994 Printer Paper (not shown)

0528-0995 Ribbon Cartridge (not shown)

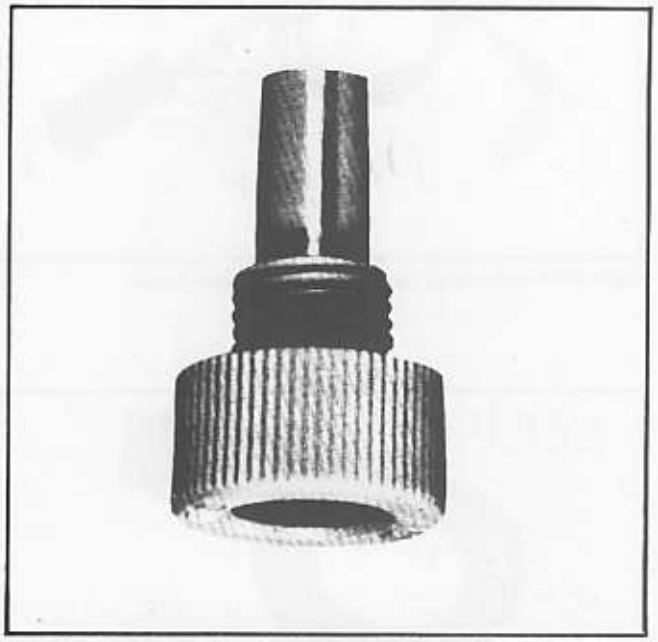


0120-0494 Mag Timing Kit

7009-1890 Mag Timing Probe Assy.

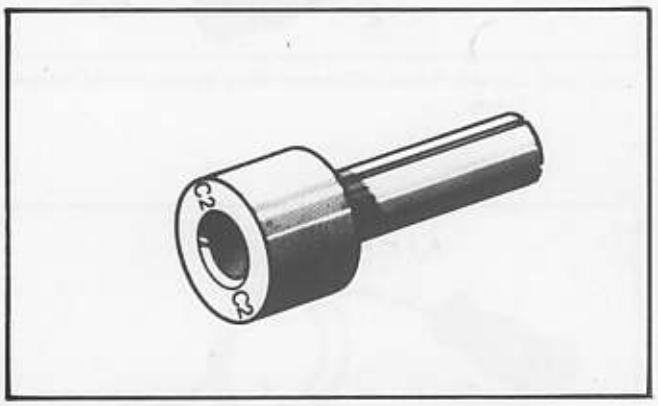


7054-56 Ford Magnetic Probe Adapter, F1



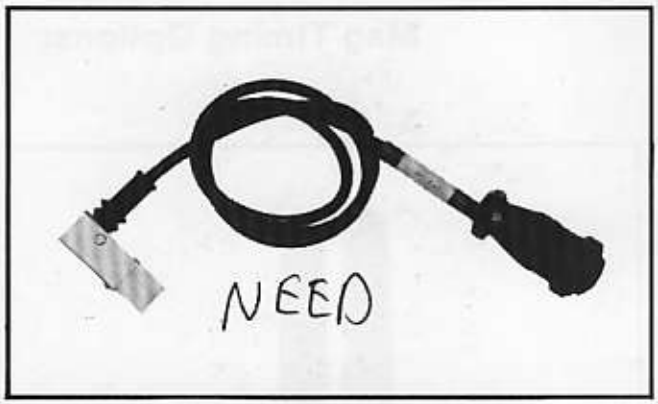
7054-60 Ford Magnetic Probe Adapter, F2

7054-57 Early Chrysler Magnetic Probe Adapter, C1

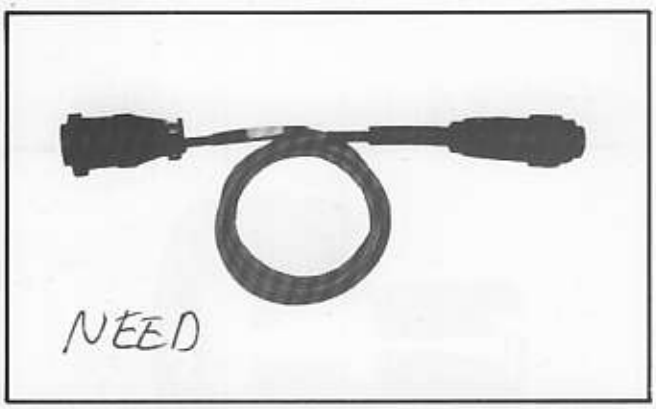


7054-62 Late Chrysler Magnetic Probe Adapter, C2

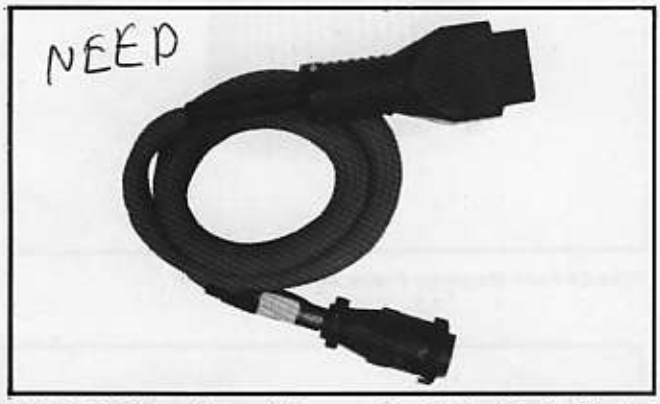
Optional Mag Timing Test Cable for European Vehicles



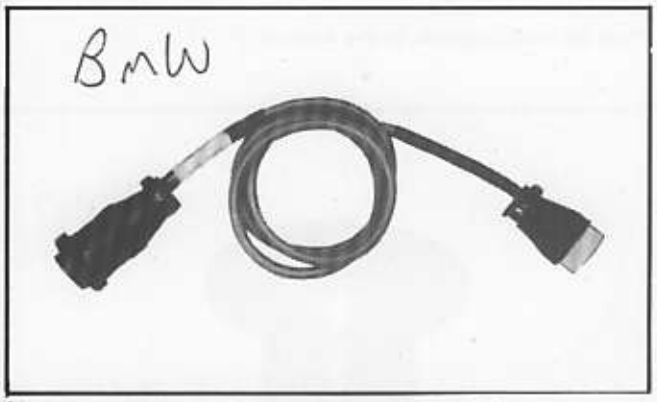
6004-0350 Volvo Mag Timing Probe Adapter Cable



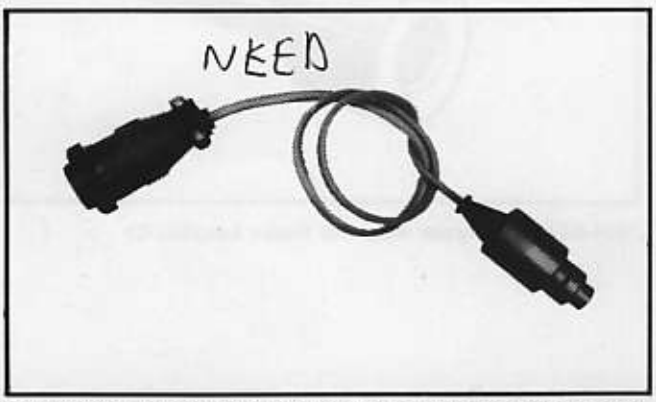
6004-0351 British Leyland/Mercedes Benz Mag Probe Adapter Cable



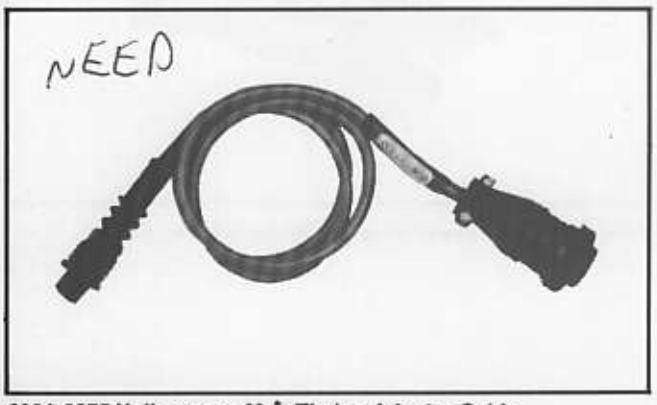
6004-0352 Citroen/Renault/Peugeot Mag Timing Probe Adapter Cable



6004-0353 BMW Mag Timing Probe Adapter Cable



6004-0354 Volkswagen/Audi Mag Timing Probe Adapter Cable

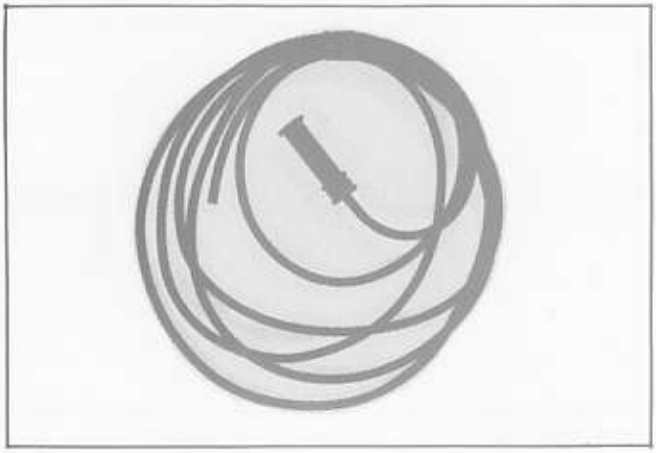


6004-0375 Volkswagen Mag Timing Adapter Cable

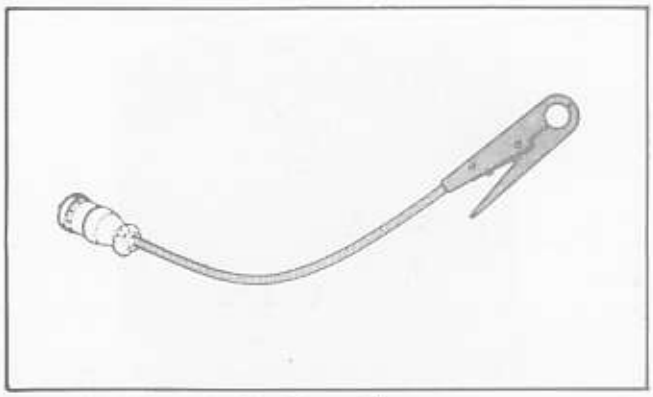
OPTIONAL (continued)

0120-0495 Amps/Vac Kit

Includes:

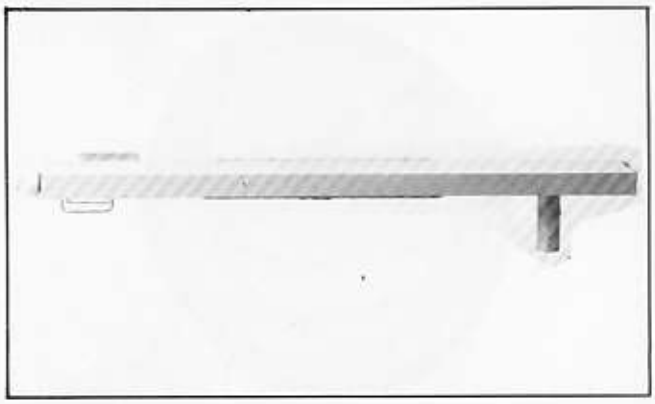


6006-0007 Vacuum Hose Assembly

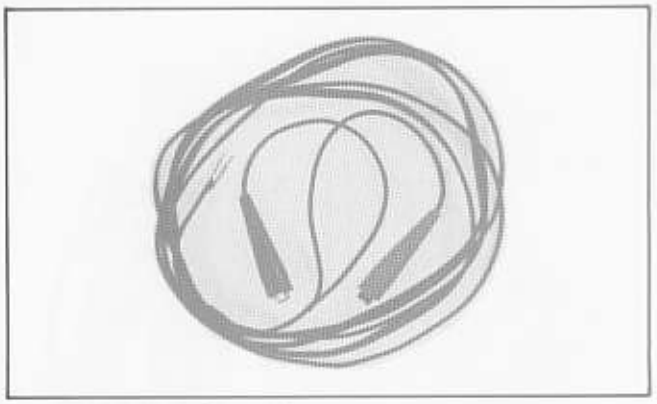


6005-0133-01 Ammeter Lead Assembly

OPTIONAL (continued)



0120-0496 Boom



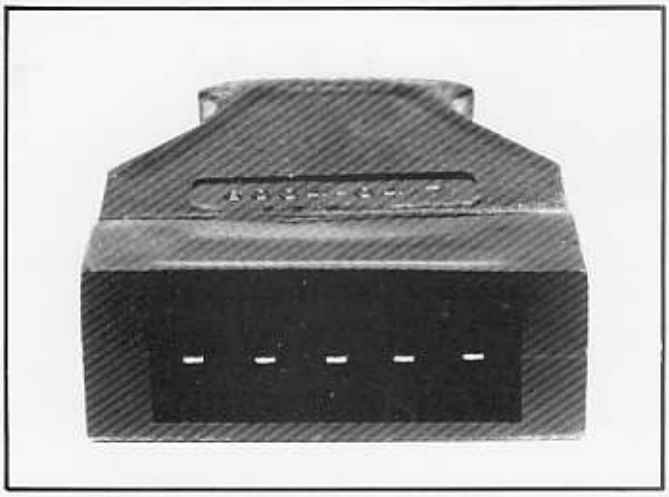
0120-0497 Coil (+) Capability

7010-0718 C-34 Test Cabinet

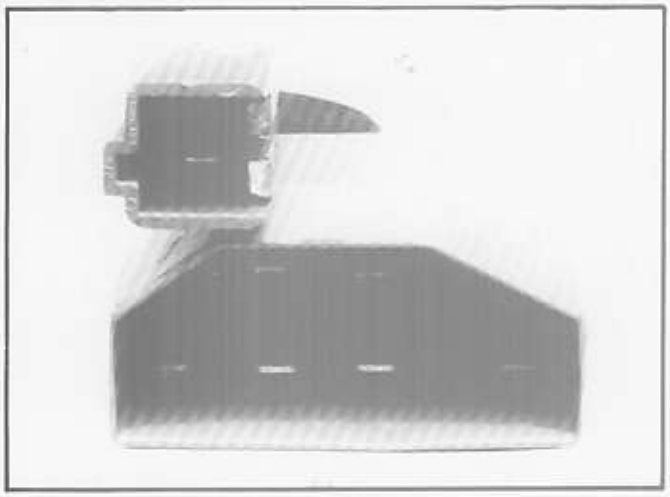
DIL-200 Distributorless Ignition Test Adapter

647-170 Tee Assembly (not shown)

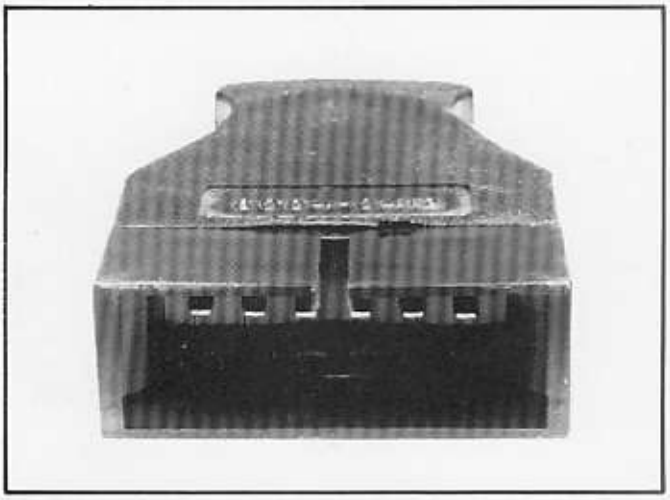
Data Link Accessories



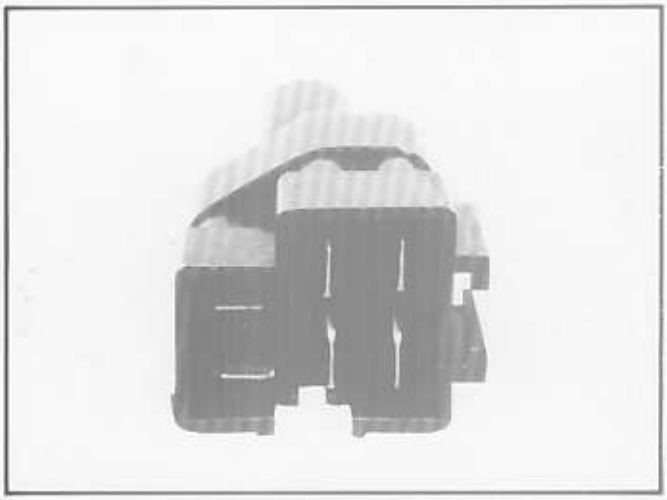
GM Twelve-Pin Diagnostic Harness PN6004-0552



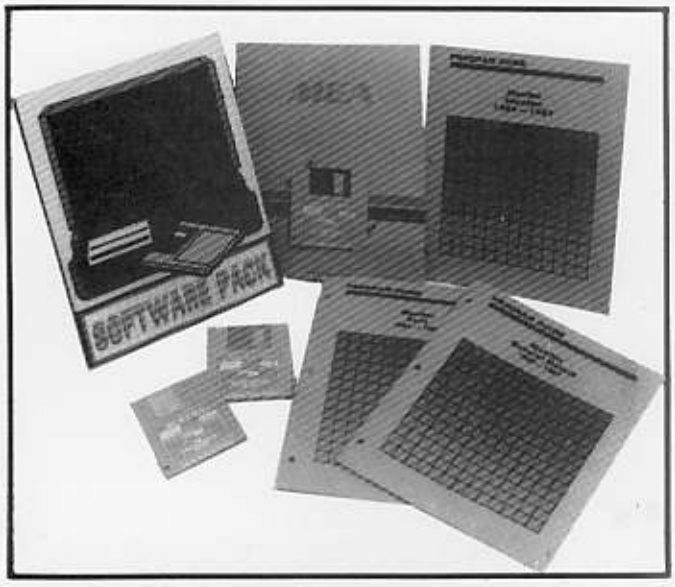
Ford Diagnostic Harness PN6004-0443



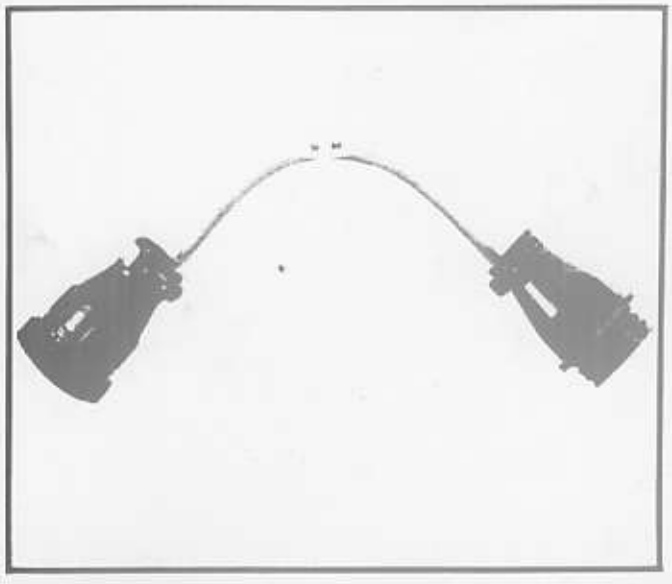
GM Five-Pin Diagnostic Harness PN6004-0417



Chrysler Diagnostic Harness PN6004-0442
Chrysler Adapter Cable 6004-0525 (not shown)



Ford, Chrysler, GM Monitor Disks



6004-0524 1987 Corvette Engine Code
8 Bidirectional Cable (optional)